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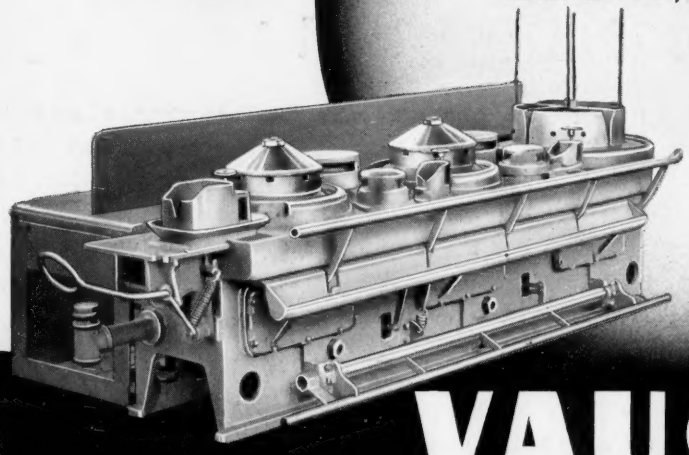

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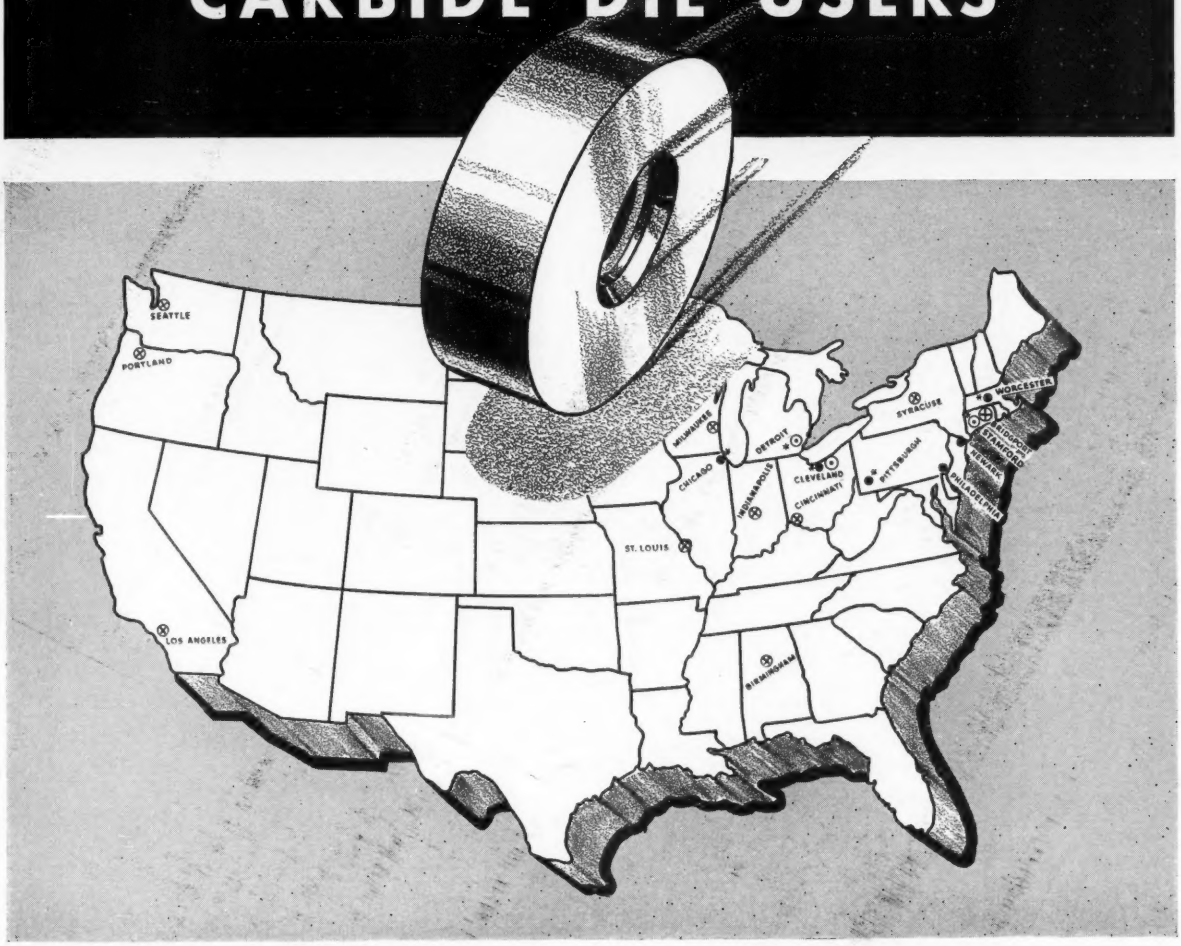


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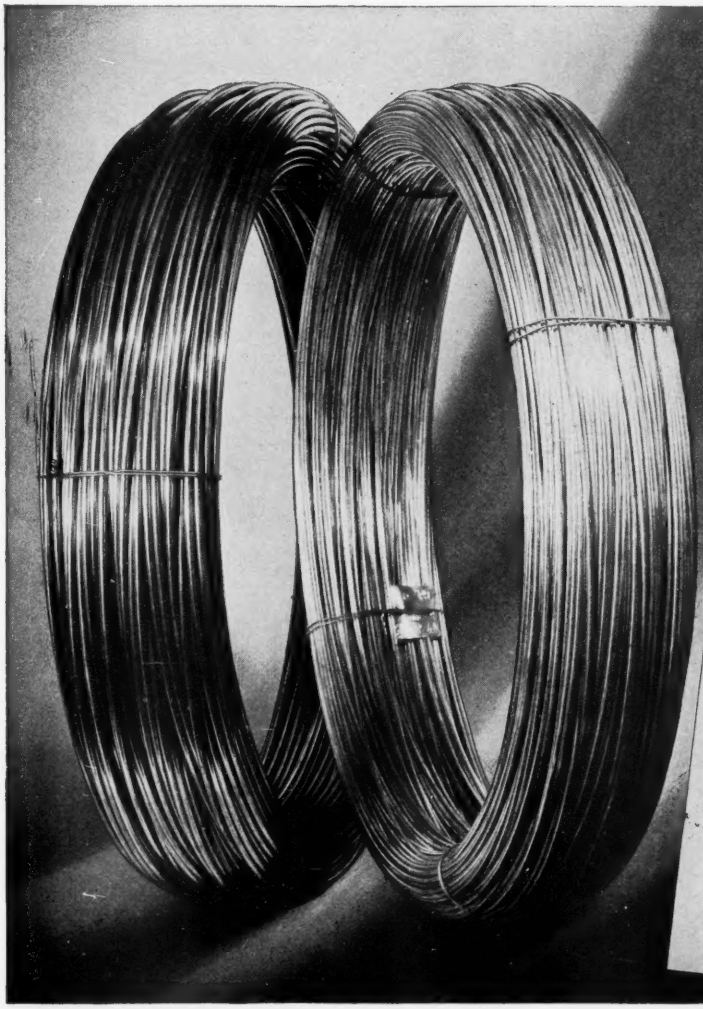

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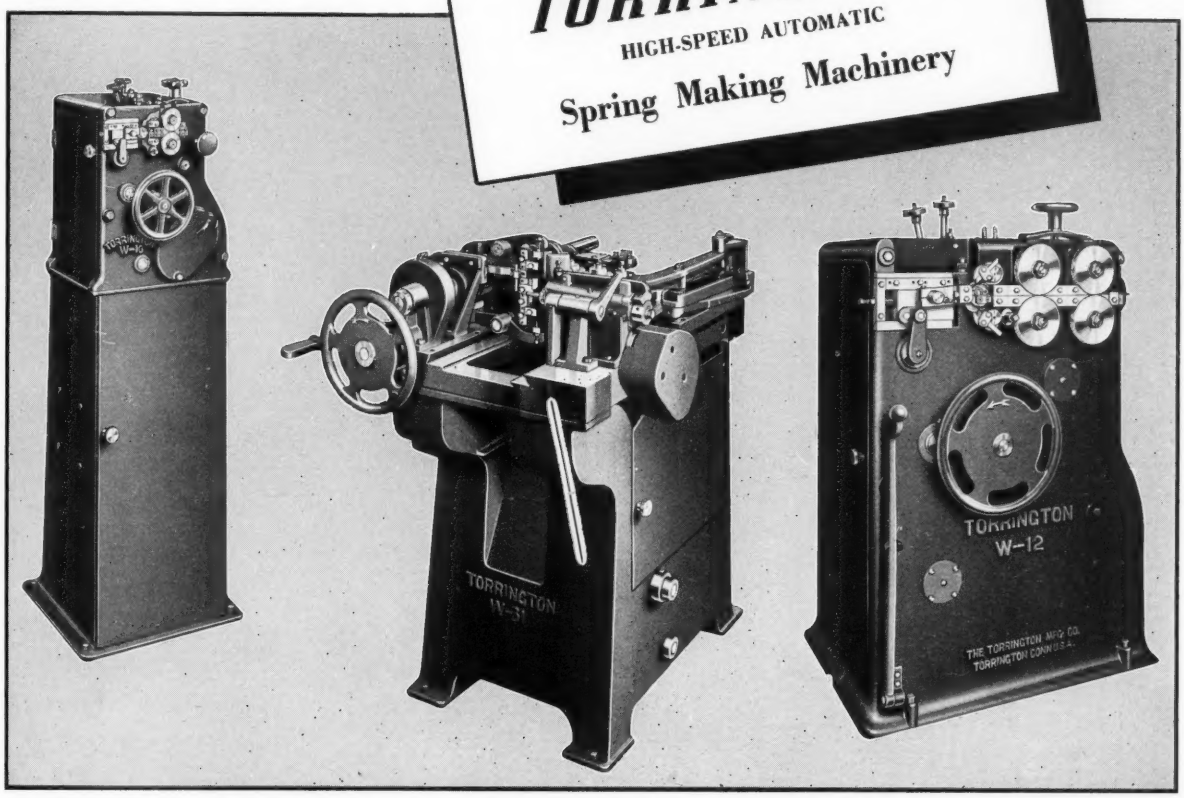


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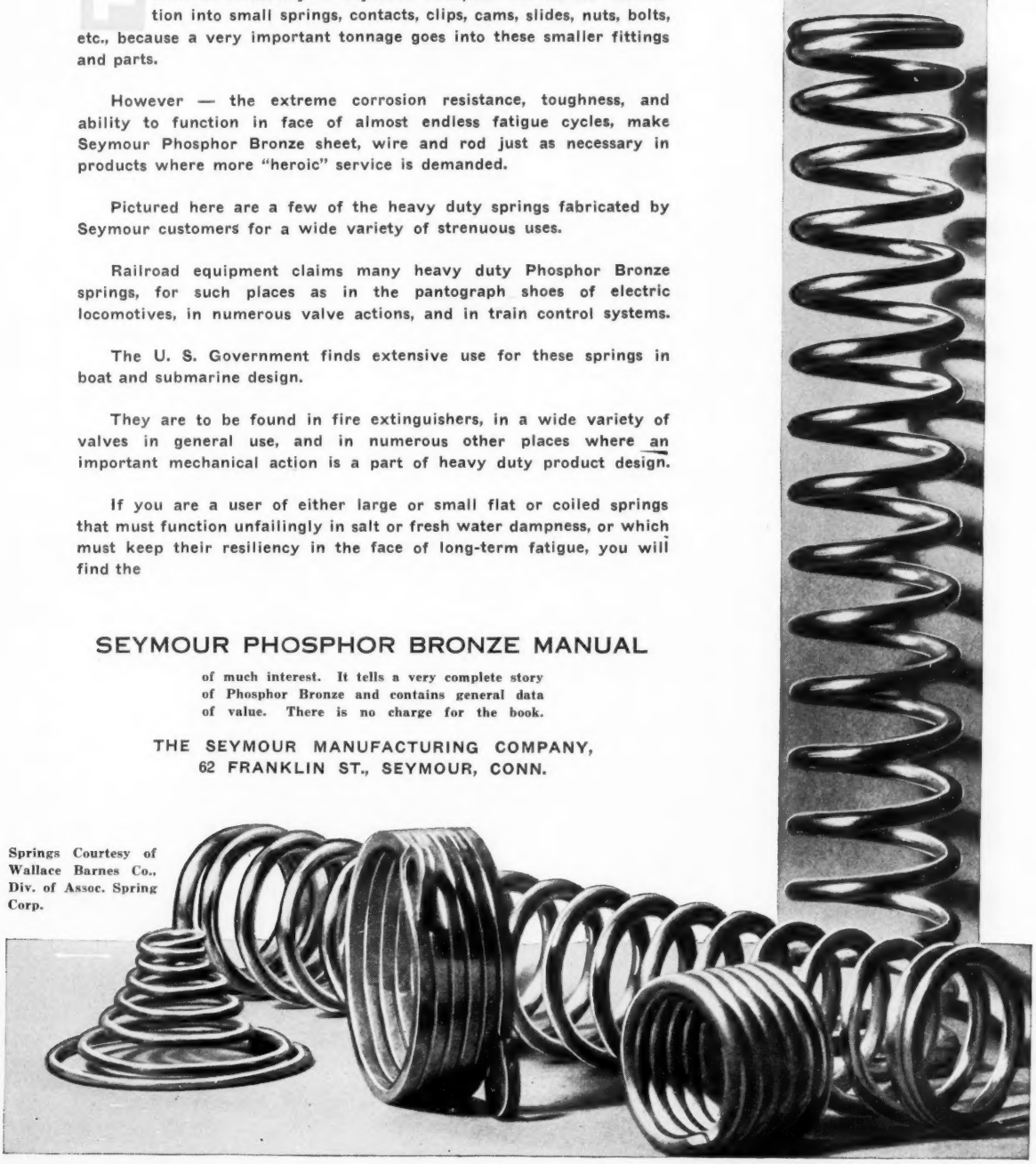

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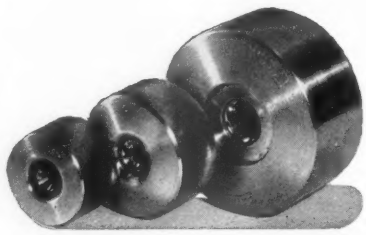

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# WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip Wire Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 12 SEPTEMBER, 1937 No. 9

Designated as

Official Publication By The Wire Association


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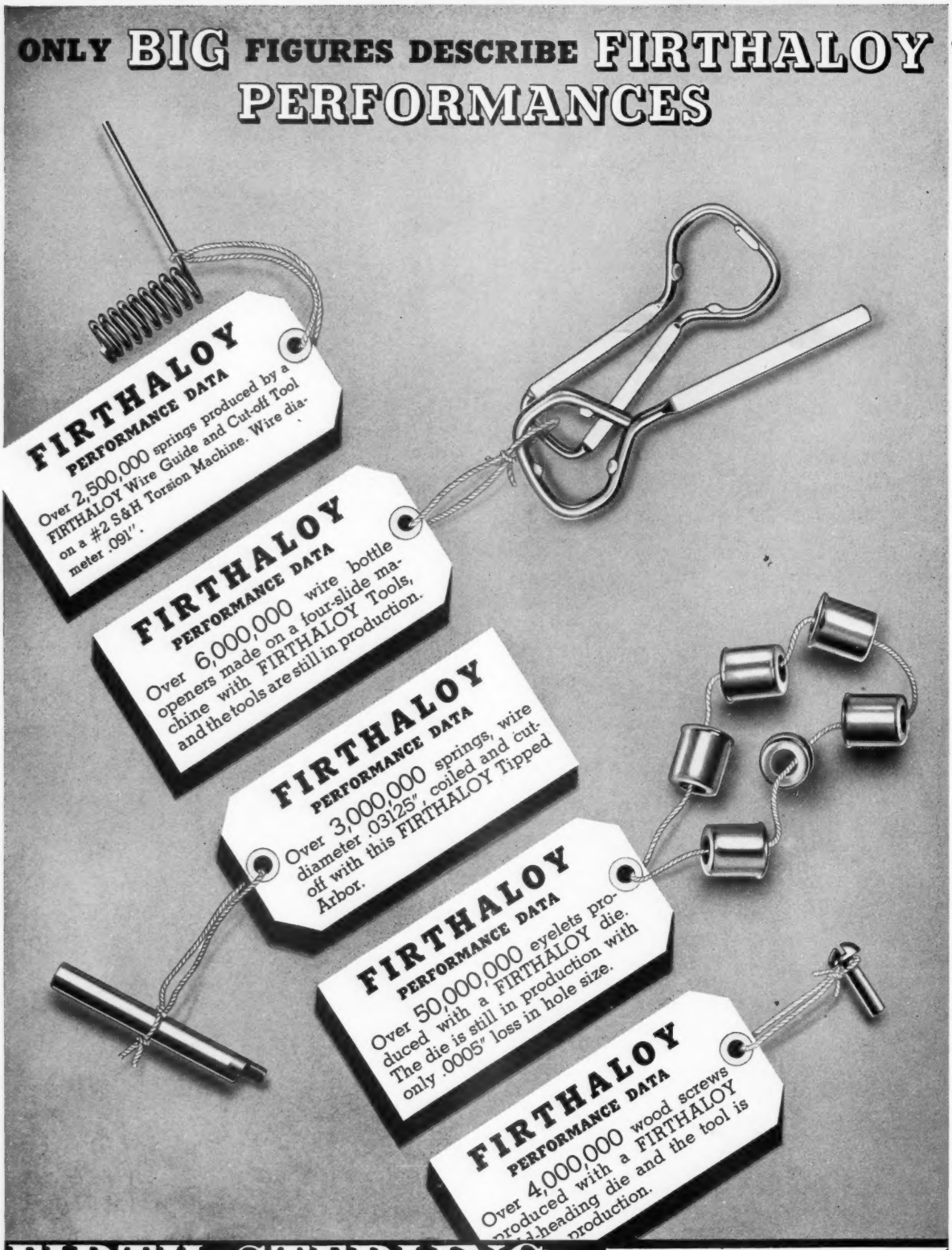
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# WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 12 SEPTEMBER, 1937 No. 9


# Wires Employed In Dentistry


By Eugene W. Skinner,

Associate Professor of Physics, Northwestern University Dental School, Chicago, Ill.


PROBABLY the first restorative dental work known in history was the wiring of loosened natural teeth, and the wiring of artificial teeth in the mouth for the replacement of lost natural teeth. The earliest records of such practice as employed by the Phoenicians date to 500 B. C. Twenty-four gauge pure gold wire was employed, but no soldering was attempted.

✦ ✦ ✦

WIRE is employed most extensively in modern dentistry as braces for the straightening of teeth, a specialty which is known as **Orthodontia.** Second in importance is its use for the construction of clasps on partial dentures or plates. The latter types of restorations are often cast, but orthodontic appliances are always constructed of wire. Wires are also employed in the treating of fractures of the jaw, but since this use is rather restricted, little will be stated concerning it.

✦ ✦ ✦

THE orthodontist employs the wires to move the teeth by spring tension. A horseshoe-shaped "arch wire" usually of 18-gauge is constructed so that it will fit entirely around the dental arch to be treated. The ends of the wire are usually anchored to a molar tooth by means of a band which is driven over the circumference of the tooth crown. This wire is then hooked to other teeth to be moved, or small cantilever "finger springs" of 24 gauge wire may be soldered to it as auxiliary springs for tooth movement. The forces applied are very small in magnitude, and the balancing of the appliance is a delicate matter, if the correct teeth are to be moved the proper amount. In order to accomplish such an operation successfully, all of the properties of the wire must be under control at all times. Although a high proportional limit and modulus of elasticity are important, considerable ductility is also necessary because of the large amount of contouring required in the adjustment of the appliance. The forces to be exerted are controlled, so far as the wire itself is concerned, by heat treatment and variance in wire diameter.

✦ ✦ ✦

THE wire clasps employed on partial dentures are exactly what their name implies. Two 14 or 16 gauge wires, round or half-round, are soldered to the denture

DR. E. W. SKINNER
Associate Professor of Physics, Northwestern University Dental School, Chicago.

TRAINING: A.B., Grinnell College, 1919. M.S., 1925,. Ph.D. 1930, State University of Iowa; major: Physics; minor: Mathematics.

EXPERIENCE: Instructor in Chemistry, Doane College, Crete, Nebraska, 1920. Professor of Physics, Olivet College, 1925-30. Associate Professor of Basic Dental Technology, School of Dentistry, Western Reserve University, 1930-34. Associate Professor of Physics, Northwestern University Dental School, 1934-.

The work at Western Reserve University and Northwestern University consists in the teaching of and research in the properties and manipulation of dental materials, largely from an engineering standpoint. These materials include plaster of Paris and its derivatives, hard rubber, synthetic resins, porcelains, gold alloys, both cast and wrought, amalgams, steels, low fusing alloys, etc. The field is large but the workers are few.

PUBLICATIONS: "The Science of Dental Materials", W. B. Saunders Company. Numerous articles in dental and other journals.

MEMBERSHIPS: American Physical Society, American Society for Metals, International Association for Dental Research, American Society for the Advancement of Science (Fellow).


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to form a horseshoe-shaped structure which clasps the tooth, and maintains the denture in position. Since the tissues underneath the denture are soft and resilient, the clasps are constantly spreading and closing during mastication. Therefore, in these structures, the endurance limit and fatigue strength must be high in addition to the properties noted for the orthodontic wires.

✦ ✦ ✦

INASMUCH as the human mouth offers very complex and varied opportunities for corrosion, because of the many changes in its chemical content and temperature, it is not surprising that the dentist relies chiefly upon gold alloys for mouth restorative and corrective purposes. Certain specifications have been drawn up for these wires by the American Dental Association Research Commission, working on a cooperative basis at the National Bureau of Standards. An idea of the composition and physical properties of these wires may be obtained from the accompanying Table I which is taken from the American Dental Association Specification No. 7. The fusion temperature, "wire method", is obtained by determining the temperature at which a sample of wire approximately 1/16 inch in length and 0.028 to 0.032 inch in diameter will break when subjected to a cross-bending load of 3 ounces avoirdupois. The yield point is tested by subjecting the sample to an initial tensile load of 20,000 pounds per square inch, after which a load of 125,000 pounds per square inch is applied. If the strain recorded between these limits is greater than 0.0085 inch per inch, the wire is rejected for certification.

✦ ✦ ✦

AS a matter of interest, there have been eight specifications compiled by the American Dental Association Research Commission to the present date for different types of dental materials, and several more are in the process of formulation. The manufacturer certifies to the commission that his product meets the proper specification, and he is then permitted to place a guarantee of such compliance in his advertising. Periodically, the Commission buys samples of such products on the open market, and tests them in their own laboratories, thus checking up on the guarantee. Lists of those products which are found to meet the given specification are published in the official journal, and it behooves the manufacturer to keep his product to standard, in order that it may appear upon the approved list. This program furnishes a very efficient guide to the dentists in the selection of satisfactory materials.

TABLE I

Requirements for Dental Wrought Gold Alloys as Given by American Dental Association Specification No. 7

| Gold and platinum group metals (Per cent by wt.) | Fusion temperature wire method (°F.) | V. T. S. (p. s. i.) | Yield Point (p. s. i.) | Elongation, 2 inch gauge length (Per cent) | |
|---|---|---|---|---|---|
| Minimum, 75 | Minimum, 1750 | "Oven-cooled" minimum, 150,000 | "Oven-cooled" minimum, 125,000 | Quenched, minimum, 15 | "Oven-cooled" minimum, 4 |

✦ ✦ ✦

## Tensile Properties of Dental Wires

MANY wire metallurgists will be surprised at the tensile properties exhibited by these wires. Under proper conditions of heat treatment, their proportional limit may reach 150,000 pounds per square inch, and their ultimate tensile strengths may be as high as 200,000 pounds per square inch. Although the wires are classed as wrought gold alloys, the actual gold content may be as low as 25 per cent by weight. Platinum and palladium are the chief contributors to strength, platinum being the more effective. These metals also raise the fusion temperature, palladium being more effective than platinum in this regard. A high fusion temperature is desirable, since hard solders are generally employed for joining purposes.

✦ ✦ ✦

OTHER metals which are commonly found in these alloys are copper, silver, and zinc. The presence of copper is very essential to heat treatment. Silver probably contributes but little, but some authorities credit it with the enhancing of ductility along with gold. Zinc is introduced in small amounts as an oxide scavenger during the manufacturing process. Various attempts have been made to introduce nickel into these alloys for economic reasons, but the better wires are devoid of this metal. Apparently the nickel tends to concentrate at the grain boundaries during the cooling of the wire, and a marked brittleness results. Furthermore, the nickel tends to lower the tarnish resistance unless it is offset by sufficient amounts of palladium and platinum, a condition which nullifies the economy sought by the introduction of this metal.

✦ ✦ ✦

## The Manufacture of Dental Wires

THE method of manufacture of these wires is slightly different from other similar processes. The metals which oxidize readily, or which are volatile, may be first alloyed with copper in proper amounts. Platinum and palladium also may first be alloyed with gold—particularly platinum, since it is prone to segregate in the melt unless sufficient agitation is provided. Gas or electric furnaces are employed. Certain manufacturers claim superior results with induction furnaces. The melting is accomplished in a crucible (usually sand), and the melt is poured

Author's Note: All alloy compositions given are manufacturer's formulae, and are protected by United States Patents.

into ingot molds of cast iron or graphite, according to preference. The shape of the ingot molds vary with different manufacturers.

✦ ✦ ✦

## Cold Working

THE bars are worked cold. For the initial reduction, they are either swaged or rolled. During this initial reduction and the subsequent reduction as well, frequent annealing is necessary. The annealing temperatures vary from 1300° F. to as high as 1700° F, depending upon the type of alloy. In rolling or swaging, the bars can be reduced approximately 0.020 inch per pass, with about 3 passes between each anneal, but these factors also vary widely with the type of alloy.

✦ ✦ ✦

## Drawing

AFTER the bars have been reduced to a diameter of approximately 1/8 inch, the reduction is continued by drawing. The dies employed may be either chilled steel or tungsten carbide, with a diamond die for finishing. Here again the annealing temperature and the amount of reduction per pass must be carefully controlled. The reduction per pass may be as low as 0.002 to 0.003 inch for small wires.

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## Quenching and Hardening

WHEN these wires are quenched from near their liquids, they are solid solutions, but if they are allowed to cool slowly, a dispersion hardening occurs which is not unlike that of the aluminum-copper alloys in effect. The exact nature of this hardening effect is not entirely known, but it is usually attributed to the formation of intermetallic compounds of copper with gold, platinum, and palladium, although such phases have never been identified by either microscopic or x-ray analyses. For a copper-gold alloy, the upper limit of this hardening range is usually given as 842° F., but the presence of platinum and palladium may elevate this limit 200° F. or more. The annealing or softening temperature for heat treating these wires is usually given as 1300° F., but it may be necessary to anneal as much as 200° F. higher if the wire is high in platinum and palladium content. All of the properties of the wire except ductility are markedly enhanced by this dispersion hardening, but the ductility may be reduced to the point of brittleness unless the treatment is properly controlled.

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## Annealing

IN practice, the dentist usually anneals the wire by bringing it

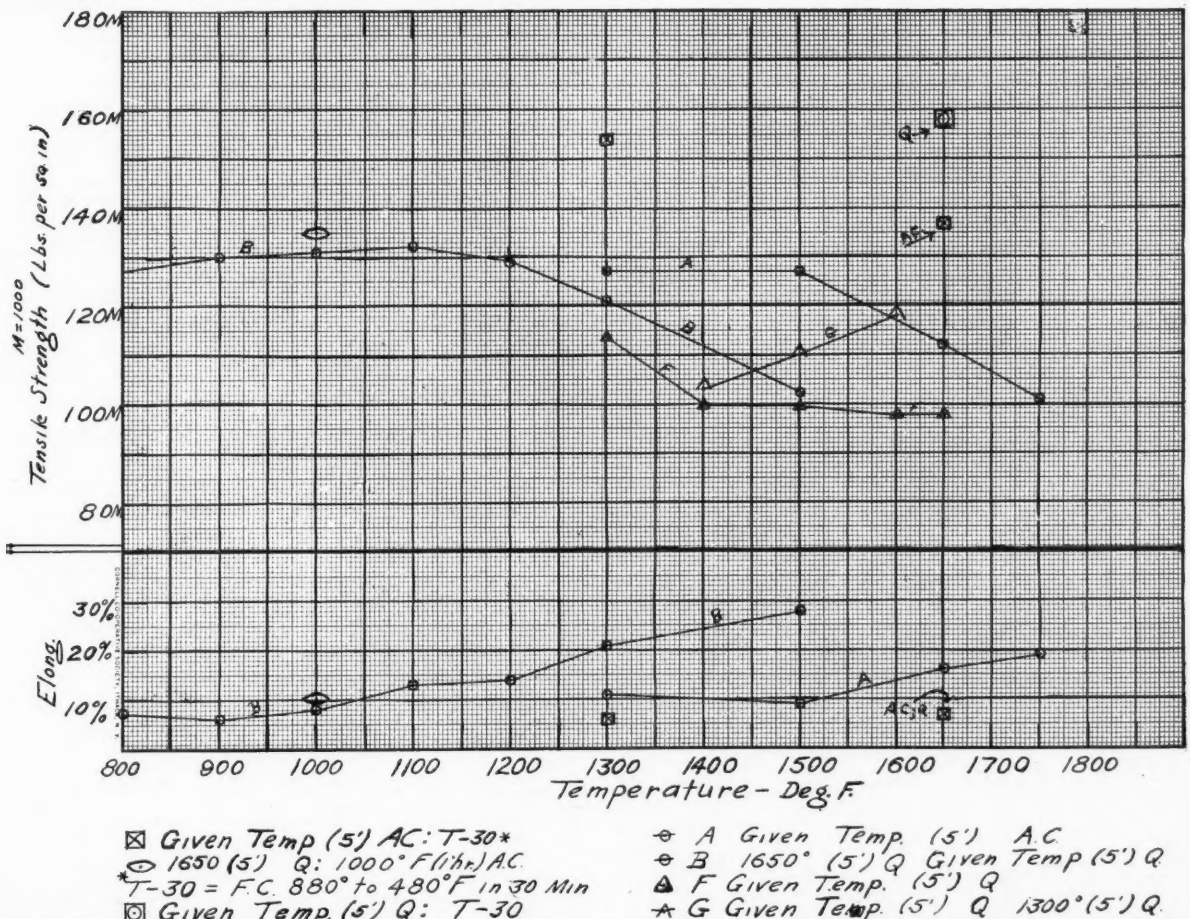


Fig. 1. Reaction of an orthodontic wire to heat treatment. Composition (percentage by weight): Au, 52; Pd, 10; Pt, 10; Cu, 8; Ag, Zn, Sn, 20. Curves A, given temperature 5 min., air-cooled. Curves B, aged 1650°F. 5 min., quenched, aged at given temperature 5 min., quenched. Curve F, given temperature 5 min., quenched, aged at 1300°F. 5 min., quenched. Squares represent oven-cooling treatment, after treatment indicated at given temperature. Ovals indicate aging at 1650°F. 5 min., quenched, aged at 1000°F. for 1 hr., air-cooled. Elongation values are for 2-inch gauge length. (Courtesy of the J. M. Ney Co. Data by R. L. Coleman.) ✦ ✦ ✦

to cherry red heat in a gas flame, and then quenching either in water or acid pickling solution. Special electric furnaces are manufactured for hardening by aging, or else by "oven-cooling" which is accomplished by allowing the structure to cool slowly through its hardening range. The oven-cooling temperatures specified for testing by the American Dental Association Research Commission consist of aging for two minutes at 840° F., then cooling uniformly to 480° F. in 30 minutes and quenching. Such a treatment is rather drastic for practical use, and a time of 15 minutes is generally employed for both aging and oven-cooling, although both time and temperature will vary for different wires.

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## Soldering

GOLD solder is employed for the joining of these wires. The orthodontic joints are usually made by holding the ends of the wires to be joined in a needle-like gas-air flame and applying the solder. The joint may be air-cooled or, preferably, quenched. However, the process employed in the soldering of clasps is usually more complicated. The parts to be soldered are first held in position with wax. They are then covered with "investment", which is a mixture of silica and plaster of Paris. The investment is mixed with water and spread over the structure to be soldered with only the joint exposed. After the investment has hardened, the wax is flushed out with hot water, and the case is soldered with a gas-air blow torch. A cleaning flux of sodium pyroborate is generally employed in both processes. Very intricate and difficult work may be accomplished by either method in the hands of a skilled technician.

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THE fineness of the solders ranges from 450 to 810, and their fusion temperatures are 1375° F. and above; the higher the gold content the higher will be the fusion temperature. Since the wires are often of a relatively small diameter, the temperature at which the soldering of orthodontic appliances is carried out is usually around 1650° F. Considerable difficulty is often encountered by the dentist in completing such soldering operations without producing grain growth in the wire, thereby weakening the joint. Furthermore, it is not always feasible for the dentist to manipulate the wires in accordance with the previously discussed rules of heat treatment. In order to combat these abuses, particularly grain growth, some manufacturers have introduced platinum and palladium into their alloys in relatively large amounts. Platinum is quite effective as an inhibitor of grain growth, but the response of such alloys to heat treatment often becomes quite complicated.

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## Heat Treatment Reactions

THE heat treatment reactions of a wire containing 10 per cent by weight of platinum and palladium each respectively are shown in Figure 1. For example, it may be noted (curve F) that the wire must be annealed at 1400°F. Since all dental restorations fabricated with wire must be soldered, the gold content of the solders employed must be carefully governed in order that the union may not be melted during the anneal. Again, if it be assumed that the soldering temperature is 1650°F., it may be noted from curve B that a temperature of 1500°F. is necessary for the anneal after soldering, a temperature which is altogether too high for the soldered

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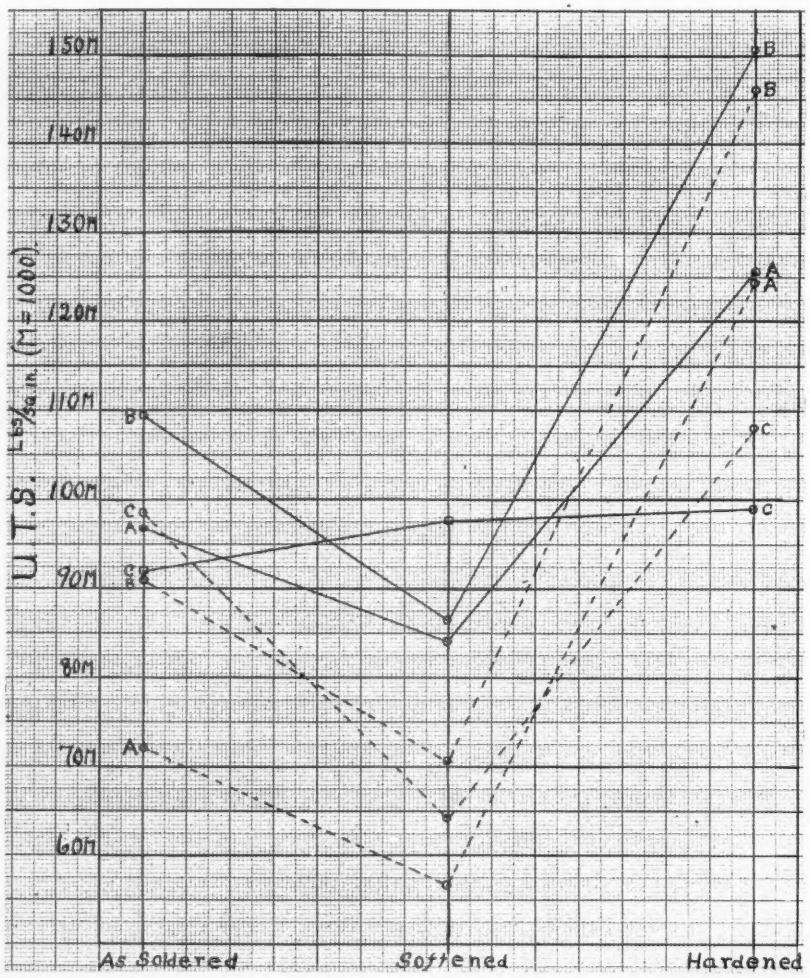


Fig. 2. Reaction of soldered joints to heat treatment; "as soldered", air-cooled after soldering; "softened" by annealing at 1300°-1400°F. for 10 min., and quenching; "hardened" by oven-cooling. Broken lines indicate joints with solder 650 fine, and solid lines for joints with solder 490 fine. Wire A same as Fig. 1. Wire B, similar to A, but with more gold content. Wire C, no gold content. ✦

# Recent Studies of Intergranular Corrosion In Nickel-Chrome Steels*

By P. Chevenard,

Director of Research, Societe de Commentry, Fourchambault et Decazeville

**The author, one of the most distinguished metallurgists of France, reviews current theory and practice and shows that fissure corrosion is a direct result of the precipitation of chromium carbide and the consequent impoverishment of areas surrounding the precipitated particles.** ✦ ✦ ✦ ✦ ✦

IN an article published in the October 1934 number of **"Aciers Speciaux"**, I summarized the results of reseaches carried on at Imphy since the year 1911 dealing with the fissure corrosion of nickel steels and nickel chrome steels in the presence of steam. As a result of these studies, an alloy formula (ATV) was worked out for turbine blades, properly applicable to all heat treating techniques. These researches threw considerable light on the mechanism of intergranular or fissure corrosion, especially in the iron-nickel-chromium-carbon alloys, and particularly on the important part played by heterogeneity in the austenitic matrix.

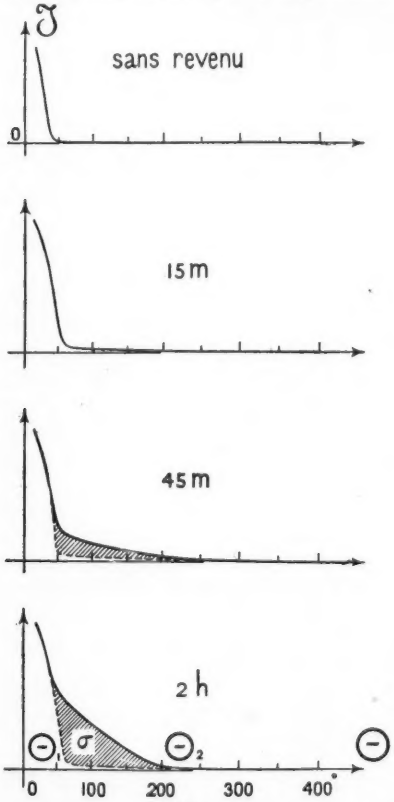


Fig. 1.

Fig. 1 & Fig. 2—Thermo-Magnetic curves of an ATV alloy quenched from 1250°C. in water, not tempered (left) and tempered for varying lengths of time at 750°. The duration is expressed at the right of each curve. ✦ ✦ ✦

* Translated by Kenneth B. Lewis from Métaux & Corrosion, Paris, France.

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THESE studies have been continued, and I now intend to set forth the results of later experiments in the heterogeneity caused by tempering after a quench, either immediately or with intermediate cold work. In order to make the subject clear, and to spare the reader the trouble of referring back to previous records I shall first discuss briefly the history of alloys of the ATV type, the conditions under which precipitation heterogeneity appears, and means for measuring its amplitude and extent. I shall then describe the effects of heterogeneity on the physical and chemical properties of the austenitic stainless steels.

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## 1. History of an Alloy

THE earliest experiments on fissure corrosion in steam were conducted with the binary ferronickels, with and without small chromium additions. The NC4 alloy, 22% Ni, 2% Cr, and 0.5% C. was given particular attention because of its great sensitiveness; a sample bar, as rolled or quenched, and then drawn through a die, and exposed to boiler steam in an autoclave, would develop deep fissures within a week.

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NC4 is definitely, though weakly, magnetic after cold working, in contrast to its completely non-magnetic character after a quench.

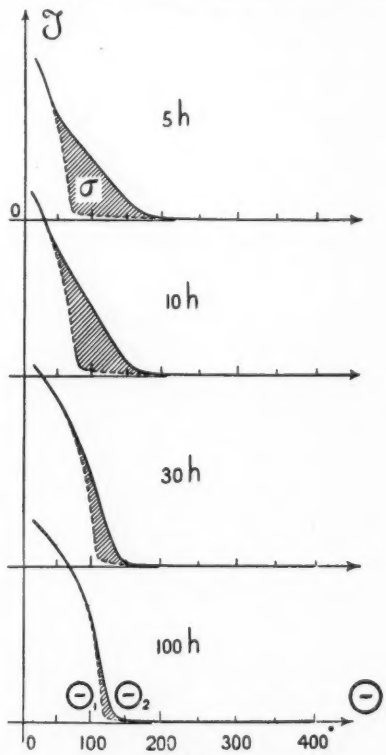


Fig. 2.

Fig. 1 & Fig. 2—Thermo-Magnetic curves of an ATV alloy quenched from 1250°C. in water, not tempered (left) and tempered for varying lengths of time at 750°. The duration is expressed at the right of each curve. ✦ ✦ ✦

This feeble magnetism has been shown to be the result of a partial reversion of gamma iron to alpha iron induced by cold working. With this in mind one would naturally suppose that the ferro-nickels could be made resistant to fissure corrosion by pushing the nickel content above $Fe^2Ni$ (34.45% Ni) which is the limiting point of alloys capable of undergoing the $\gamma \rightarrow \alpha$ transformation upon cooling. This expedient, however, is known to be ineffective; some of the invar wires (35 to 36% Ni, .05 to .10 C) developed fissures within a few months.

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BUT the invar wires that are most susceptible to fissuring are those richest in carbon. This gives rise to a second hypothesis linking fissure corrosion to the instability of invar at room temperatures. **M. Ch.-Ed. Guillaume** has recently worked out the mechanism and the cure of this instability. Its cause is a gradual precipitation of carbide of iron and manganese, due to carbon put into super-saturation during heating for rolling or annealing.

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IT requires only a small addition of chromium or vanadium or any of several elements to inhibit this instability. Would not such additions also inhibit fissuring? Since the failure of turbine blades is so serious it would seem prudent to adjust the alloy so as to cover both hypotheses, that dealing with the $\gamma \rightarrow \alpha$ transformation and that relating to the part played by carbon. Carbon is of course necessarily present in all ferrous alloys in which strength is a desired characteristic. Hence the adoption of a nickel content above the $Fe^2Ni$ point, and a large amount of chromium. The ATV alloy (34% Ni, 11% Cr. 0.3% C) used during the past twenty years for turbine blades resists fissure corrosion admirably.

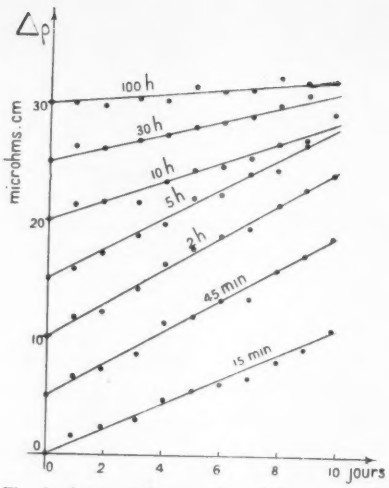


Fig. 3—Apparent increase in resistance $\Delta\rho$ of samples of ATV quenched and tempered at 750° for varying intervals and then exposed to hypo-hydrochloric mixture.

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BUT, unless it confirms a well worked out theory, a negative result empirically arrived at proves nothing. Therefore efforts have been directed toward clarifying the mechanism of fissure corrosion, and they have thrown some light on the role of heterogeneity of the austenite.

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## 2. Quantitative studies of Heterogeneity of Ferromagnetic Austenite

THE alloy ATV is magnetic, and its Curie point is low enough to be conveniently measured. Its magnetic transformation is greatly affected by heat treatment. The alloy is made up of an austenite matrix and of chromium-rich carbide, and the distribution of chromium and carbon between the austenite and the carbide depends upon the previous treatment. Chromium in a ferro-nickel lowers its Curie point; a study of the Curie point therefore indicates how much chromium is dissolved in the austenite.

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BY this method, physico-thermal analysis, one can follow very closely the progress of solution of carbides during heating, and of their precipitation during cooling or upon tempering after a quench The precipitation of carbide

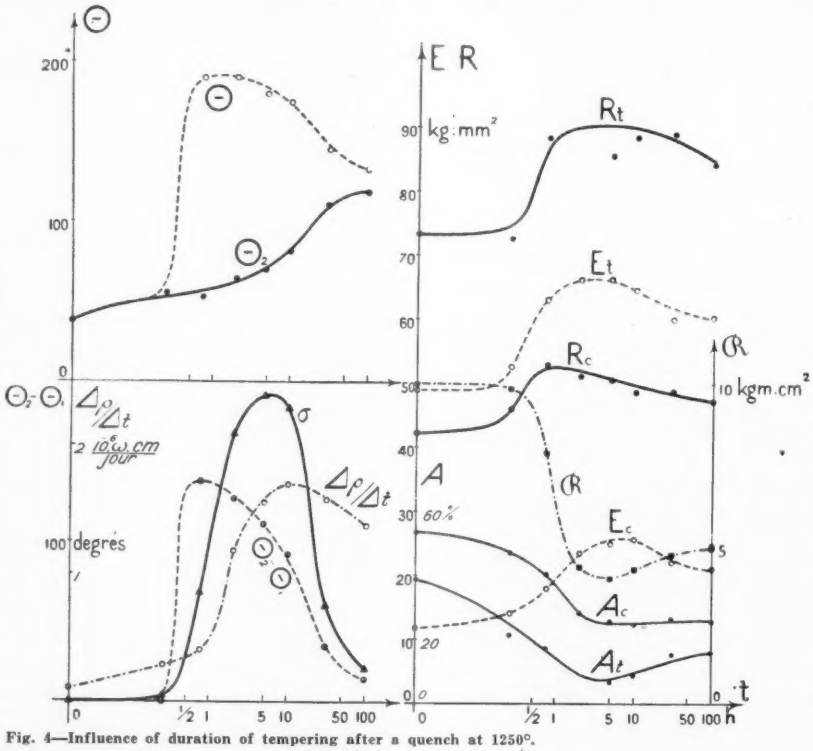


Fig. 4—Influence of duration of tempering after a quench at 1250°.
On parameters of heterogeneity, $\Theta_1$, $\Theta_2$, $\Theta_2 - \Theta_1$, $\sigma$.
On tensile, $R_t$, elastic limit, $E_t$, and elongation $A_t$.
On the same properties in shear $R_c$, $E_c$ and $A_c$.
On impact text R.
Tempered at 750°

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practically always determines the heterogeneity of the austenitic matrix.

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BEFORE a grain of carbide can form and precipitate, there must have been a centripetal migration of the elements necessary to its formation. Each carbide grain, therefore, as soon as it forms, is surrounded by an area poor in chromium and carbon. This barren area tends, of course, to disappear through diffusion, but it persists after cooling if the tempering is of short duration, or if it has been conducted at low temperatures at which diffusion is slow.

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THE existence of these impoverished areas, thus postulated, may be proven by thermo-magnetic analysis. The austenitic solid solution, in which different areas have differing percentages of chromium, and therefore different Curie points, undergoes a progressive magnetic transformation, varying with the temperature. This abnormal transformation is indicated by most of the time-magnetism curves of figures 1 and 2. They not only reveal very sensitively a heterogeneous austenite, they also supply a means of estimating quantitatively the **amplitude** and **extent** of the heterogeneity.

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THE amplitude, that is to say the greatest difference in chromium concentration, can be deduced from the two extreme Curie points of the austenite $\Theta_2$ and $\Theta_1$. Previous experiments have established the relationship between the Curie points of an iron-nickel chromium alloy and its chromium content. If, as is sometimes the case, $\Theta_2$ approximates the Curie point of a pure ferro-nickel, it may be safely concluded that the impoverished areas are practically free from chromium.

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AS for the extent, that is to say the percentage of the total austenitic volume affected by

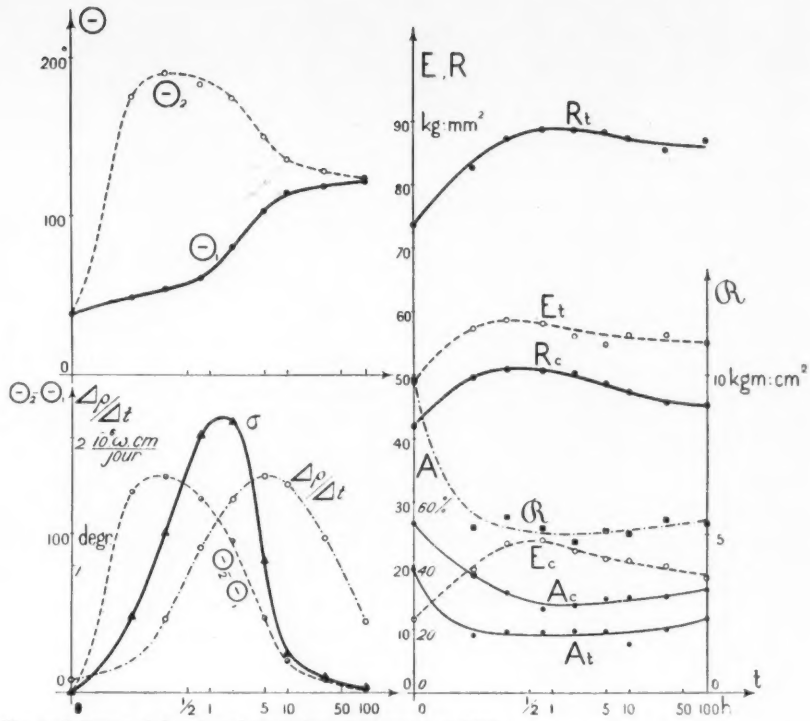


Fig. 5—Influence of duration of tempering after quench at 1250°.
On parameters of heterogeneity, $\Theta_1$, $\Theta_2$, $\Theta_2-\Theta_1$, $\sigma$.
On tensile, $R_t$, elastic limit, $E_t$, and elongation $A_t$.
On the same properties in shear $R_c$, $E_c$ and $A_c$.
On impact text R. Tempered at 800°

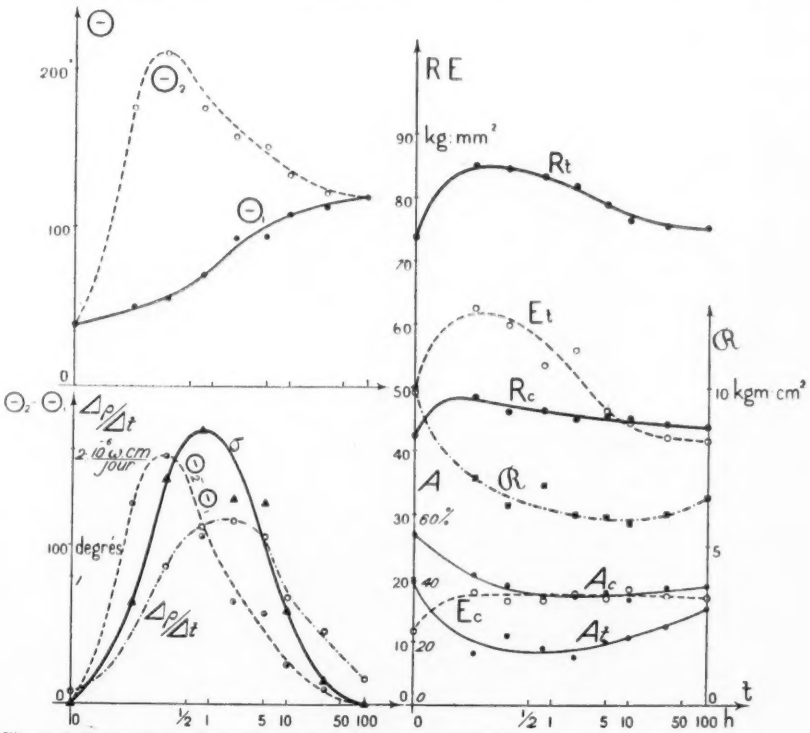


Fig. 6—Influence of duration of tempering after quench at 1250°.
On parameters of heterogeneity, $\Theta_1$, $\Theta_2$, $\Theta_2-\Theta_1$, $\sigma$.
On tensile, $R_t$, elastic limit, $E_t$, and elongation $A_t$.
On the same properties in shear $R_c$, $E_c$ and $A_c$.
On impact text R. Tempered at 850°.

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heterogeneity, it is shown in arbitrary units by the area σ which lies between the time-magnetism curve and a curve drawn tangent to its upper portion.

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THE chemical sensitivity of the alloy, that is to say its susceptibility of intergranular corrosion, may also be quantitatively determined. **M. Waché** of the Imphy laboratories has found a sulphurous reagent capable of bringing out the chromium-poor areas very accurately. This is a mixture of photographers' hypo and hydrochloric acid. After exposure to this reagent the surface of a heterogeneous alloy shows grains separated due to the leaching out of the barren areas, and the electrical resistance of the specimen is increased. The increase in resistance $\Delta\rho$ is often roughly proportional to the time (fig. 3). The angular coefficient $\Delta\rho/\Delta t$ is therefore an index of intergranular corrosion.

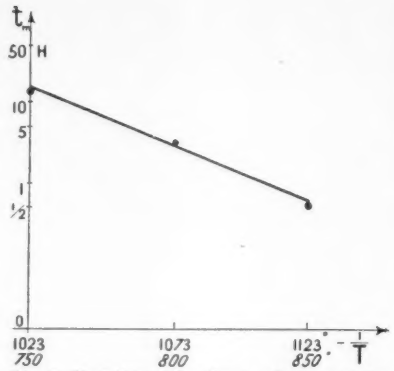


Fig. 7—Variation of duration $t_m$ abscissae at the peak of curve $\sigma$ with absolute temperature of tempering, T. ✦ ✦ ✦

### 3. Relation between precipitation heterogeneity and chemical and physicial properties of an ATV type alloy quenched and tempered.

WITH these quantitative methods it is easy to study the effect of heat treatments on precipitation heterogeneity in a nickel-chrome steel, and their combined effect on chemical and physical properties.

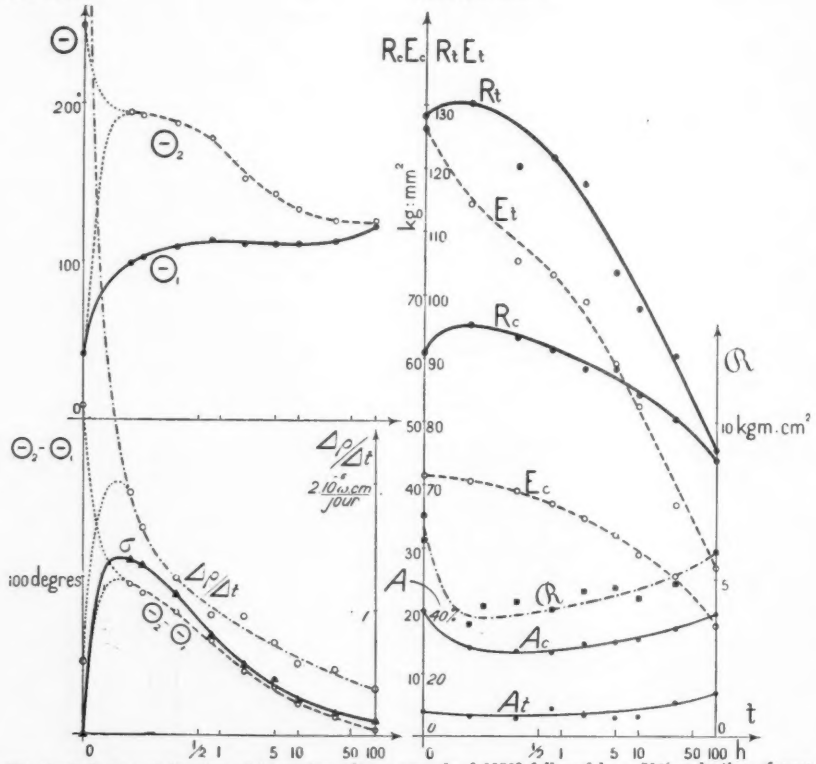


Fig. 8—Influence of duration of tempering after a quench of 1250° followed by a 50% reduction of area
On parameters of heterogeneity, $\Theta_1$, $\Theta_2$, $\Theta_2-\Theta_1$, $\sigma$.
On tensile, $R_t$, elastic limit, $E_t$, and elongation $A_t$.
On the same properties in shear $R_c$, $E_c$, and $A_c$.
On impact text R. ✦ ✦ ✦ ✦ ✦ ✦ ✦

THE three diagrams, figs. 4, 5 and 6, relate to an ATV alloy quenched at 1250° C. and tempered for various lengths of time up to 100 hours at three temperatures, 750°, 800° and 850°. The test bars, 3.5 mm. diameter were heated in a muffle of ATV placed inside a closed silica muffle so as to prevent decarburization. The cycle was the same in all cases; a temperature rise of 200° per hour, and a 30 minute soak at 1250°. Similar precautions were observed in tempering, where the temperature was held constant to within a degree.

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TEST pieces were machined out for thermo-magnetic analysis, for tensile and shearing tests, and for impact. Bars for corrosion test were given a very light finishing cut to take off any metal which, in spite of all precautions, might have been decarburized. About 0.5 mm was removed, at a very low speed so as to avoid cold working the metal.

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IN these diagrams the time scale is logarithmic, the abscissae being proportional to log. (1 + N), N being the length of the temper expressed in minutes. A similar scale, large for short time intervals and decreasing as the phenomena subside, is convenient for presenting clearly the influence of time t on the effectiveness of the tempering. Each diagram has 12 curves. Some show the parameters of heterogeneity; these are, the temperatures $\Theta_2$ and $\Theta_1$ of the extreme Curie points, the amplitude of heterogeneity expressed by the difference $\Theta_2-\Theta_1$ and its extent expressed by the area σ. The curve $\Delta\rho/\Delta t$ expresses, as stated, the activity of intergranular corrosion. The other curves relate to physical properties; tensile strength $R_t$, elastic limit $E_t$ elongation on tensile fracture $A_t$, the corresponding shearing characteristics, $R_c$, $E_c$, and $A_c$ and the impact resistance, which was determined by the small Pomey machine. ✦ ✦ ✦

AMONG the facts brought out by these diagrams the following are well known:

1—THE hardening of an alloy upon tempering after a quench begins with the appearance of the phenomena of heterogeneity, and consequently precedes the precipitation of carbides. These results add to the proof that the disturbance of homogeneity of the solid solution, which takes place before the separation of the constituent which precipitates, is one cause of the increase in hardness during the development of structural hardening.

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THE effects of temperature increase in rapidity as the temperature rises. The displacement of the peak of the σ curve toward its origin, and that of the E and R curves of physical properties follows the law:

$$tm = C.^{\frac{T}{B}}$$

C and B are constants and T is the absolute temperature. This formula resolves into:

$$\log t_m = \log C - \frac{B}{T}$$

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THE semi-logarithmic diagram shown as fig. 7 brings out the fact that points representing $t_m$ plotted as functions of $-\frac{1}{T}$ form practically a straight line.

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2. THE shape of the $\Delta\rho/\Delta t$ curve gives evidence as to the part played by heterogeneity in intergranular corrosion.

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THE ATV alloy, resistant to corrosion in the quenched state in which it is a homogeneous solid solution, regains its resistance if given a tempering long enough to again homogenize the austenite which surrounds the precipitated carbides, but while the austenite is heterogeneous the alloy is very sensitive to chemical influences.

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CURVES $\Delta\rho/\Delta t$ follow σ curves more closely than they do those of $\Theta_2—\Theta_1$. From what has gone before one would be inclined, on the contrary, to assign more importance to amplitude of heterogeneity than to extent, because the electromotive force of the local piles of corrosion depends upon amplitude. But electromotive force is not the only factor in the chemical attack. Given two aggregates of the same constituents, that whose grains are the finer will, according to M. Portevin, be more resistant. A heterogeneity of great amplitude will result from a relatively short low temperature tempering, where diffusion has not time to be effective. The most barren areas are therefore also the finest in grain, and their fineness compensates in some measure for their heightened electromotive potentialities.

Fig. 9—Appearance of a sample quenched, cold drawn, not tempered, and immersed 2 days in hypo-hydrochloric reagent. ✦

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## 4. Influence of cold work after quenching and before tempering.

THE great influence of cold work is apparent upon comparing diagrams 4 and 8, in which conditions as to heat were identical. In fig. 4 there was no cold work between the two thermal treatments, but in fig. 8 the specimen was given a reduction of 50% of area in a wire drawing die.

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THE first result of the cold work was greatly to increase the effectiveness of the tempering. Without cold work the peak of the σ curve was reached after 12 hours at 750° C., while in the cold worked specimen it was reached in less than two minutes. As for the they show the resultant of two phenomena, the progressive softencurves of the physical properties, ing as the effect of cold work was erased, and the progressive hardening due to precipitation. Hence the initial rise in the tensile curves $R_t$ and $R_c$ and the rapid drop of the impact curve R.

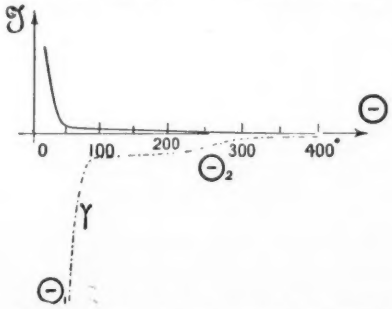


Fig. 10—Thermomagnetic curve of a sample quenched and cold drawn but not tempered. This is the same sample as Fig. 9. The curve γ shows the Curie points $\Theta_1$ and $\Theta_2$. ✦

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TURNING now to the sensitivity to fissuring, the results brought out in the curve $\Delta\rho/\Delta t$ for tempering times between two minutes and 100 hours indicate what cold work does in speeding up this phenomenon. The resemblance between the $\Delta\rho/\Delta t$ and the σ curves is apparent, and is entirely consistent with the physical effects of tempering. But one fact of importance frequently overlooked is the great sensitivity occasionally found in an alloy **before** the tempering. This sensitivity is not always in evidence; from one test to another the $\Delta\rho/\Delta t$ relation varies within rather wide limits. Sometimes the quenched and wire-drawn specimen is attacked scarcely more than a quenched bar. In other cases there is a localized attack on one part of the specimen. In still others, intergranular corrosion penetrates to the center after only two days exposure to the hypo-hydrochloric mixture (fig. 9).

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A CLOSE examination of the thermo-magnetic curve shows at about 200° a Curie point $\Theta_2$ which is barely discernable until the diagram is redrawn as in fig. 10. This great sensitivity is therefore attributable to a heterogeneity of great **amplitude** but of negligable **extent,** and also doubtless to internal strains due to cold work. It has not yet been possible to clear up these inconsistencies. They seem due to very small variations in the initial character of the

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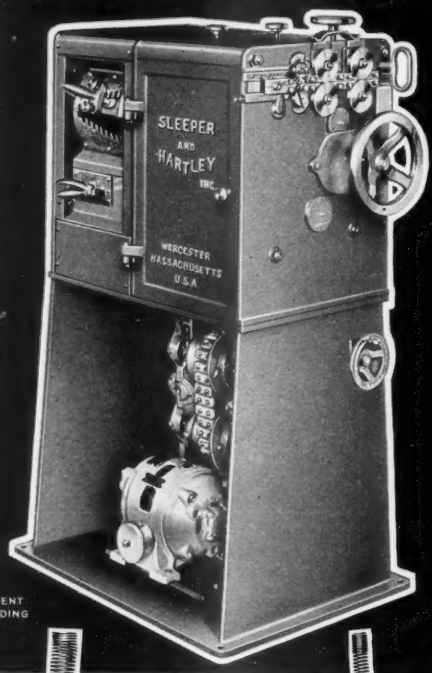


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J. W. Rockefeller, Jr., Section Editor.

Vol. 12 SEPTEMBER, 1937 No. 9

# The Development of Today's Scale Spring

By J. W. Rockefeller, Jr.
Consulting Engineer, New York, N. Y.

Special treatment of wire involved in the manufacture of scale and precision springs and the necessity, therefore, are described in this article. ✦ ✦

THERE is, perhaps, a no more interesting application of the wire spring, than in the field of instruments, for it is in this modification that the laws of stress and strain are most readily apparent and long before such phenomena as "creep" and "hysteresis" became subjects of wide investigation in the general engineering field, the maker of scale springs had to face them as a practical problem.

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SCALE springs have been made and spring scales used for a period of over two hundred years, and in view of the scant knowledge, at that time, of the nature of metals, it is remarkable that such a serviceable article was turned out as long as a century ago. There are scale springs in use today which are representative of almost every stage of development for the past hundred years.

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IT is difficult to determine in what form springs were used most extensively in the first few years of spring scale's adoption. Today, the elliptic spring is still being used as a measuring element in heavy capacity traction dynamometers. The recently developed ring-type proving instrument, used for checking testing machines, in both tension and compression is a refinement of the earlier circular or elliptic type spring used in commerce for many years in Europe, although never widely used in this country.

✦ ✦ ✦

AS far as the development of spring scales in this country is concerned, the helical extension spring, at a very early date, became the standard form of measuring element. During the very earliest period, springs were coiled of tempered wire, and since no two springs calibrated alike, it was necessary to calibrate the instrument to fit the characteristic of the individual spring. This procedure was, of course, expensive as well as inconvenient, since it was practically impossible to replace a spring which had failed in service. It also accounted for a non-uniformity of graduations on the dial of the scale, and in place of the circular dial which indicated a complete revolution of the pointer, with the full load upon the platform, the graduations on the circular dial stopped short of covering the full circumference.

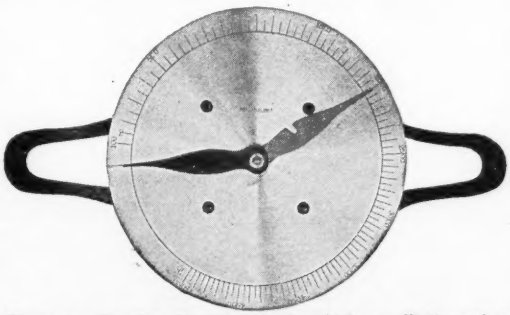

Figure 1. Traction dynamometer, in which an elliptic spring is used as the force measuring element. The dial of this instrument is calibrated to fit the individual spring. ✦

✦ ✦ ✦

ONE of the most important improvements in scale springs came with the development of the pre-calibrated spring which was closely coiled with no initial tension between adjoining coils. This was accomplished by using an annealed wire, and coiling a length of springs upon a lathe. After this operation, the springs were cut to length, hooked

and wired. The wiring operation was usually accomplished by passing two wires of small gauge through the center of the spring, bending and bringing up along the outside, after which the two ends were twisted together. The purpose of wiring the springs was to prevent the coils from opening during the subsequent heat treating operations.

✦ ✦ ✦

IN the case of springs produced in large quantities, wiring has more recently been accomplished with a single wire upon a four-slide machine, and the operation is performed in about one-tenth the time required by the hand method.

✦ ✦ ✦

FIFTY years ago, the heat treatment of the coiled scale spring consisted in case hardening and quenching, and drawing at a lower temperature.

✦ ✦ ✦

THE case hardening was designed to raise the carbon content in the outer layers of the wire (from about .85% to 1.00% or more, usually) and was accomplished by packing springs in new or charred bone. Sometimes new bone was mixed with charred, and the heat treater was the man who decided the mixture to be used, as well as the temperatures at which the springs should be quenched and drawn.

✦ ✦ ✦

SPRINGS designed for operation at high stresses, were sometimes hardened to such a degree that they would break under load, before giving any visible signs of permanent deformation.

✦ ✦ ✦

IT was usually the case, that very little space had been left in the scale for the accommodation of the spring. A scale which had been designed, let us say, for weighing of loads up to one hundred pounds capacity, would become the starting point in design for a two hundred pound capacity scale. The first step would be to attempt to fit the heavier capacity weighing element into the original housing. Such procedure resulted frequently in the manufacture of springs which had to operate at abnormally high stresses, and it is remarkable, in view of the scarcity of knowledge of metals of the time, what the spring maker was able to accomplish.

✦ ✦ ✦

WITH the refinement of spring scale design, and the general penetration of engineering methods into most fields of manufacture, the necessity for better instrument springs became apparent. Manufacturers of indicating scales, from the counter-type to the largest track scales became interested

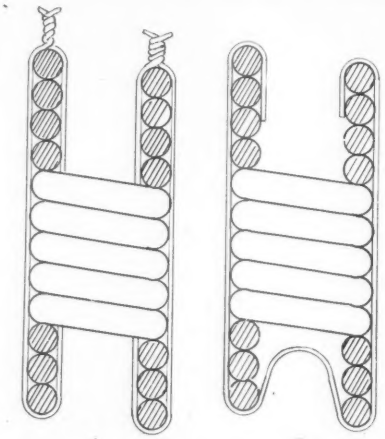


**Figure 2. Methods of wire springs (a) by hand. (b) by machine. Many scale springs are wired in this manner to prevent distortion during thermal treatment.** ✦ ✦ ✦ ✦

in the spring as a substitute for the troublesome counterweight. One of the marked disadvantages of the spring, as a force measuring element, was the effect of temperature upon its modulus of elasticity. Many ingenious devices were developed for counteracting this effect. In counter scales, it was frequently compensated for, by devices which would change the distance from the fulcrum point to the nose iron as temperature changed. In some track scales, the scale head was kept at an even temperature by means of a thermostatically controlled electric heating element.

✦ ✦ ✦

SUCH devices have now pretty generally given way to a scale spring of special metal, the elasticity of which, is unaffected by temperature changes.

✦ ✦ ✦

A NUMBER of methods have been employed to calibrate instrument springs. One of the earliest and most satisfactory, is a metal calibrator, which is run to one end of the spring and permits adjustment of the active length of the spring coil. This may be in the shape of a screw plug or a flat sheet metal runner containing holes through which the wire of the spring is threaded. A more recent development used in highly accurate springs is a sheet metal runner with a slot for the accommodation of the wire of the spring. This slot is equipped with set screw and after the wire of the spring is threaded through it the set screw is set tight to prevent any angular or lateral displacement of the wire. Another method of calibrating is by grinding the wire after the spring is formed. This method has been used for some time in calibrating springs which are manufactured with hooks on both ends, the calibration of which, through the use of a calibrator is impossible.

✦ ✦ ✦

THIS method of calibrating a spring is gradually going out of use, because of the weakening effect on the spring (the grinding operation damages the surface of the wire at which point the greatest wire fibre stress in torsion takes place) and the waste which frequently occurs through over-grinding, render the spring too weak for the purpose for which it is made. Double hook precision springs are made today, which are within a small fraction of one per cent accurate by coiling the spring with one hook and forming the other hook after the spring has been weighed off. Springs of this type are not generally used in scales but are often used successfully in railway signaling apparatus and other applications.

✦ ✦ ✦

## Lining up Hooks or Ends of Precision Springs

IN the manufacture of helical extension or torsion springs it is

sometimes necessary to keep the ends or hooks in perfect alignment. When such springs are formed of annealed wire and heat treated after coiling, there is a possibility that the ends or hooks will undergo angular displacement with respect to one another.

✦ ✦ ✦

IN heat treating steel wire springs, experiments were recently carried out to determine the amount of displacement the formed ends of the springs would undergo during the heat treating process. In these experiments, a high manganese steel of the following analysis was used:

| | |
|---|---|
| **Carbon** | **.50 to .53** |
| **Manganese** | **.68** |
| **Phosphorus** | **.019** |
| **Sulphur** | **.023** |
| **Silicon** | **.19** |

✦ ✦ ✦

VARIOUS heats of wire were tested for hardness with a Rockwell hardness test and the following table shows the variations in Rockwell hardness of the wire as obtained from the mill.

✦ ✦ ✦

| Specimen No. | Rockwell Hardness |
|---|---|
| 1 | 86 |
| 2 | 99 |
| 3 | 89.5 |
| 4 | 89 |
| 5 | 91 |
| 6 | 89 |
| 7 | 98 |
| 8 | 94.5 |
| 9 | 93 |
| 10 | 96 |

✦ ✦ ✦

THE springs, after forming, were hooked at both ends, the hooks lining up as shown in Figure 3a. After hardening it was found there had been a displacement of the hooks with respect to one aother. This displacement, becoming greater as the Rockwell hardness of the specimen increased, springs were then coiled in a single length and subjected to heating at a temperature of 300° Fahrenheit. It was found that at this temperature the ends of the coils had undergone no displacement with respect to one another. These coils were then cut into springs and hooks formed, after which they were subjected to the regular heat treatment. It was found the ends had become displaced during the treatment. A single length of coil was then heated in a molten salt bath for 20 minutes at a temperature of 1450°F. and permitted to cool slowly in the air. After this treatment it was noted that the ends of the coil had undergone angular displacement with respect to one another. The coil was then cut into springs, hooks were formed on them, and the springs were put through regular thermal treatment. It was found after the treatment that the hooks had undergone no angular displacement with respect to one another.

✦ ✦ ✦

IN general, it was found that the greater the hardness of the annealed wire, as indicated by Rockwell tests, and also by the degree of "spring back" from the coiling lathe, the greater was the degree of angular displacement of the ends in the heat treating process. By accurate measurement of the hardness of the wire, its action during heat treatment can be pretty accurately foretold. Springs of harder wire may be hooked short as shown in Figure 3C, and the heat treating depended upon to bring the ends into alignment.

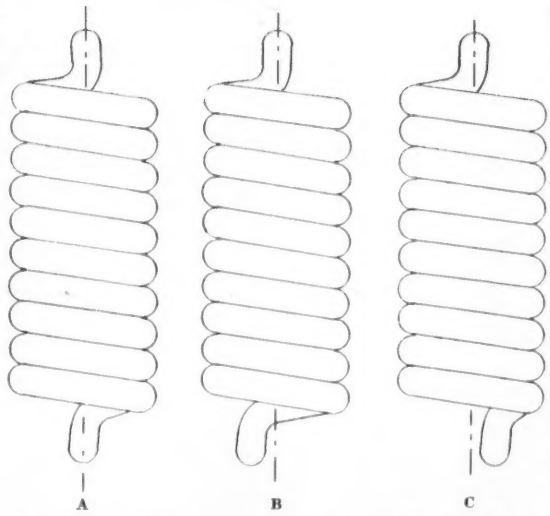


Figure 3. Effect of heat treatment upon the relative position of hooks. (a) annealed spring (b) displacement of hooks due to heat treatment. The degree of disulacement is governed by the hardness of the wire. (c) annealed wire spring hooked short to allow for displacement during heat treatment. ✦ ✦

✦ ✦ ✦

THE matter of displacement of hooks forming the ends of springs, during heat treatment is simply one of the problems with which the instrument spring maker of today is confronted. In the manufacture of precision springs for testing instruments, a record is kept of every heat of wire and every bit of information regarding it, obtainable in the most up-to-date laboratory equipment, is recorded.

✦ ✦ ✦

THE effect of straining the wire previous to heat treatment as in the case above cited is carefully investigated. From a simple coil of wire which constituted the first scale spring, the scale spring of today was developed, into a spring of special cross-section wire and special alloy. To prevent rotation of the ends during deflection, the direction of coiling is reversed at the center of the coil, or two springs in a series used, one coiled in a right-hand, and one in a left-hand direction.

✦ ✦ ✦

PRECISION springs are used as a controlling or measuring element in testing aparatus, signaling instruments, oil well pressure gauges and a variety of other uses. It would be difficult, indeed, to recognize today's instrument spring as the direct descendent of the spring which weighed produce, which our great grandfathers purchased one hundred years ago.

The 1937
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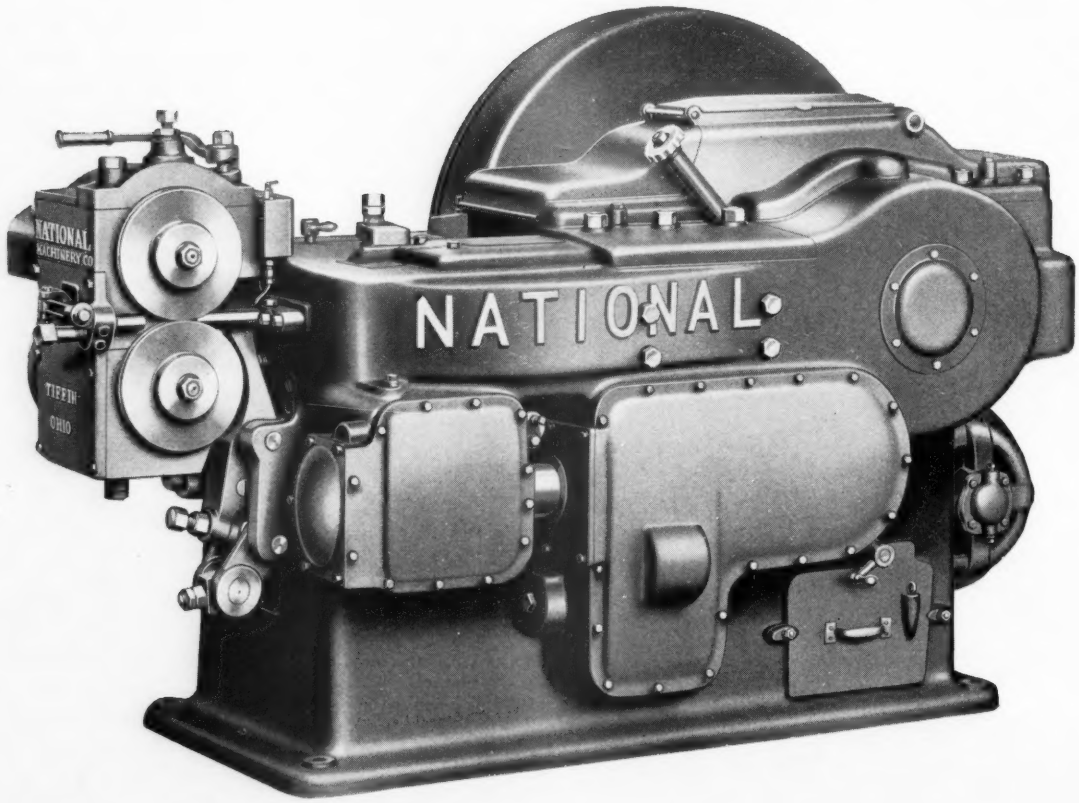


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Vol. 12 SEPTEMBER, 1937 No. 9


# Recent Progress In Cold Heading Machinery


By R. H. Jones,

National Machinery Co., Tiffin, Ohio.



**A review of the improvements in cold heading machine design and construction which have occurred during the past few years.** + + +


IT is no exaggeration to say that there have been more revolutionary improvements in Cold Heading Machine design and construction during the past few years than in any previous period in the history of the industry. With the advent of the modern automobile, aeroplane, etc., there came demands for stronger, more accurate and at the same time cheaper bolts, rivets and screws. Realizing that the conventional type of Cold Header could not be improved to entirely meet these new and exacting conditions, the Engineering Staff of The National Machinery Company set out to develop an entirely new and original design of Cold Header.

+ + +

THE objectives were more accurate, stronger and better finished output; greater over-all production, and longer die life and reduced upkeep expense. It is the hope that a review of what has been done in this new line of machines to accomplish these objectives will prove of interest to the readers of Wire & Wire Products.

+ + +

IT is obvious that the factors which influence the accuracy of the work produced also have a decided bearing on its strength. If the stock is centrally upset, it not only results in a more accurate bolt or screw, but also in a stronger one, because there is no weaving of the metal at the juncture of the head and the shank. The fibers are, consequently, not ruptured at this point and there is less chance for the head to fail when the bolt is put into service. Translated into machine design, this matter of accuracy and strength of product means a non-springing bed frame and positive alignment of the tools during upsetting.

+ + +

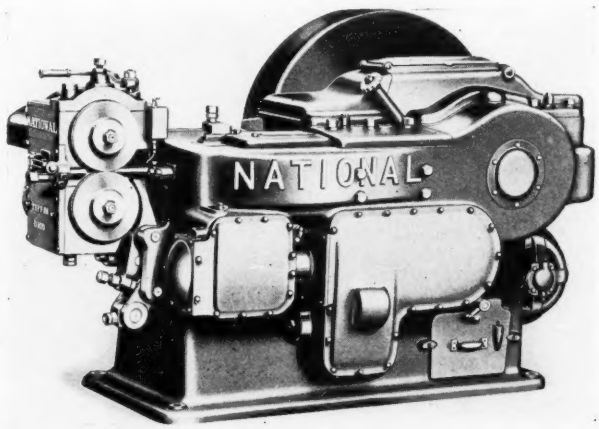


Fig. 1.

+ + + + + +

TO obtain the necessary rigidity, previous ideas of Cold Header bed frame design had to be discarded. It is a well-known engineering fact that spring in a bed frame—cross-sections being equal—is proportional to its length. As a result, the new type bed frame is of exceedingly short, compact and massive design. It is a heat treated steel casting instead of cast iron. It has heavy transverse and longitudinal ribbing, which extends entirely to the floor. Exhaustive tests of this new type frame have proven it so rigid and unyielding that none of the energy of the machine is uselessly consumed in springing the bed or working parts. Practically all of the heading energy goes into useful work, and the heads of the bolts or screws produced are sharply filled without pounding of the dies. Fig. 1 is a photograph of one of these new type machines, and will serve to convey some idea of its unusually rugged design and construction.

+ + +

A RIGID, non-springing bed frame coupled


(*Please turn to Page 482*)

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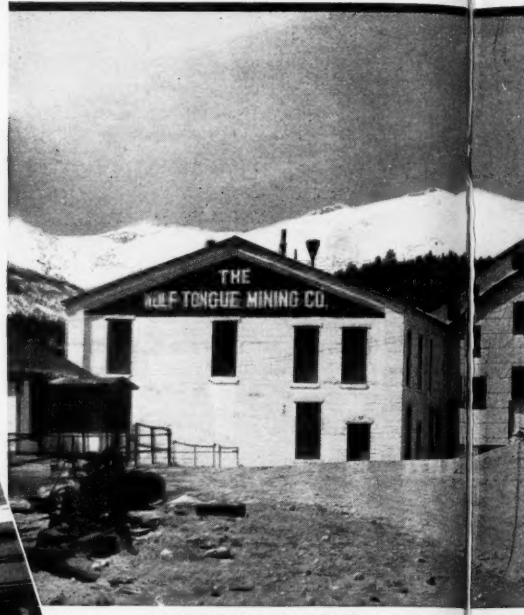


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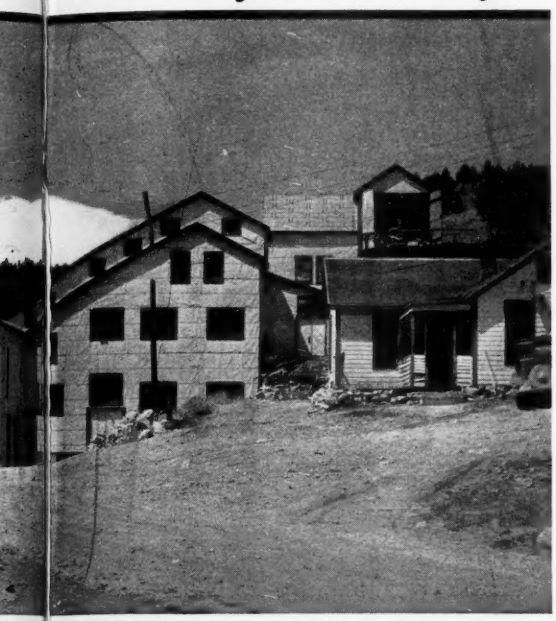

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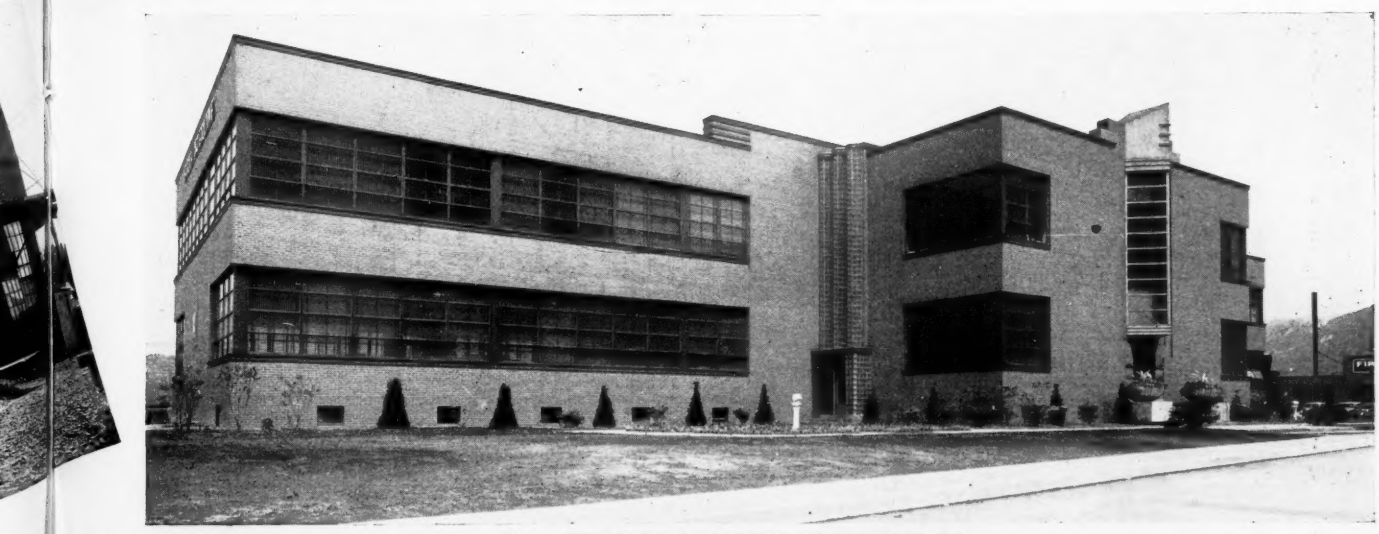

NEW FIRTHALOY PLANT, McKEESPORT, PA.

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(*Continued from Page 479*)

with a heading slide possessing accurate alignment, has been a combination that, in the past, has been almost impossible to attain. The bed frame, of course, had to be short and compact to give the necessary freedom from spring, while the heading slide had to be long and narrow to provide the necessary alignment. In the case of these new Cold Headers this unique combination of a short bed frame and a long heading slide has been obtained by the adoption of an over-arm heading slide which is carried up and over the main shaft, having both front and rear bearings, with the main shaft located in between. Unlike previous slides which are inherently short because they are of necessity located entirely in front of the main shaft, this new long, narrow, pilot-ed over-arm type of slide provides such extreme accuracy of alignment as to entirely solve this difficult problem. It is clear that the longer the slide the more accurate will be its straight line movement. Since this over-arm slide is practically double the usual length it is obvious, even to one not familiar with this type of equipment, that this machine can gather increased lengths of stock and obtain concentric, evenly filled heads. Due to the highly accurate alignment provided by such a long slide, there is less chance for side play to cause "lopsided" cones and "off-center" heads.

✦ ✦ ✦

TO further insure trouble-free operation at this point, a pitman of simple and rugged construction has been adopted. In combination with an extremely large diameter pin working in plain round bronze bearings, this pitman is a marked aid in obtaining increased outputs because the need for repairs or adjustments at this point has been practically eliminated.

✦ ✦ ✦

IT would avail nothing in the effort to provide accurate tool alignment if the tools themselves were not rigidly held in position during the upsetting operation. Consequently, in addition to a short

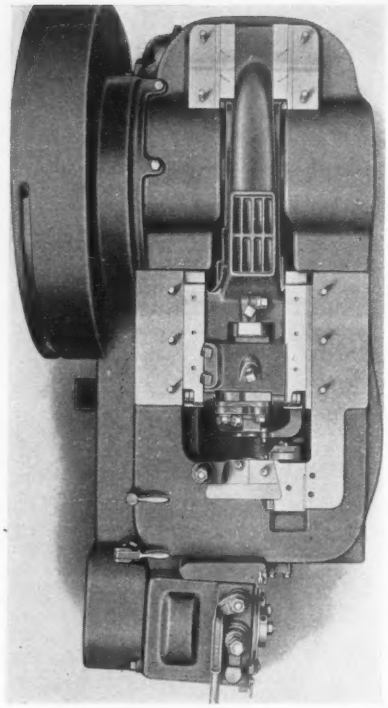

Fig. 2. ✦ ✦ ✦ ✦

bed frame and a long heading slide, means must also be provided for securely locking the tools after they have been shifted to the heading line. This matter of a satisfactory tool shifting mechanism also presented a difficult problem. It not only affects the accuracy of the product but the speed of the machine as well. After many ideas were tried and discarded, an oscillating type of shifter mechanism was finally developed and adopted. With this new construction, the coning and heading tools are rocked into and out of operating position with an easy oscillating motion about a fixed center. There is no shock or noise of impact when

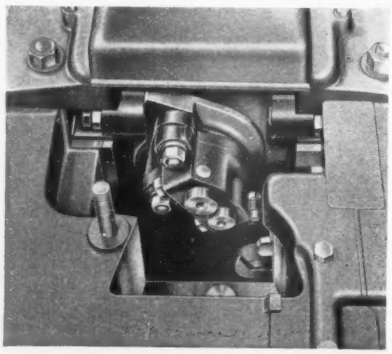

Fig. 3. ✦ ✦ ✦ ✦

these tools come to a definite stop in either position. The tool holder is mounted on the end of a large diameter spindle, which in turn is carried in a large block in the heading slide. The heading thrust is taken directly on a hardened plate of large area. The tools are automatically locked when in their heading position, by an actuating lever which is nearly on dead center at the time of upsetting. Due to the fact that the shearing action leaves the end of the blank higher on one side, there is greater tendency for the tools to shift sidewise than vertically. However, with this new construction the upper end of the tool holder rocker is against the abutment screw, while the actuating lever at the opposite end is nearly on dead center. The tool is, consequently, securely locked between these two joints and horizontal, as well as vertical shifting is prevented. The entire arrangement is protected against accidental damage by a fully automatic relief, if for any reason the tool holder cannot complete its full stroke when the tools are being shifted into and out of upsetting position. The entire mechanism is exceedingly simple, and tool adjustments are easily and quickly made. Fig. 2 shows the new heading slide construction and Fig. 3 is a view of the oscillating tool holder.

✦ ✦ ✦

THE invention of this new heading tool rocker mechanism provided the third essential factor for accuracy in the work produced—the first two being a rigid bed frame and a heading slide that would remain in accurate alignment. There is still another factor which has a decided bearing on the accuracy of the work produced—the dragging action of the shear.

✦ ✦ ✦

TO assist in obtaining central and uniformly filled upsets the feed rolls of the new machine are set at an angle, (see Fig. 2), which compensates for the dragging action of the cutter when it severs the blank from the coil. In addition, a new type of cut-off and carry-over mechanism has been developed. The cutter is carried in a rugged

arm which oscillates back and forth between the cut-off station and the heading line on a large diameter pin which is fixed in the bed frame. The cam action which controls the movement of this arm is such that the cutter engages the stock with a comparatively slow but positive movement, rather than a vicious blow. After the blank is severed the movement accelerates and completes the cycle more rapidly and smoothly than has been possible heretofore. The result is a greatly improved cut-off, which not only gives a better end on the blank but enables higher operating speeds to be maintained because of the easy oscillating motion about a center.

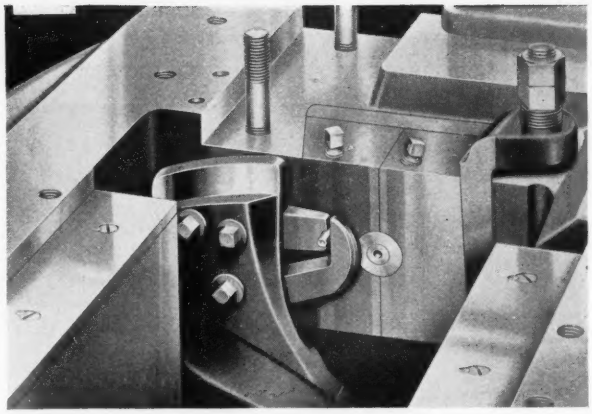

Fig. 4.

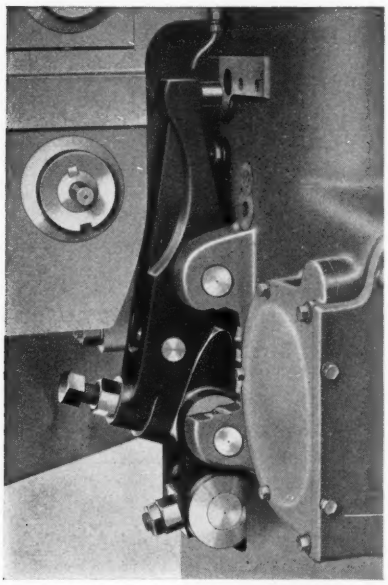

Fig. 5

✦ ✦ ✦

THE conventional spring fingers for holding the blank in the cutter while it is being carried to the heading line have been discarded in favor of a positive acting, mechanically operating gripping finger. There is, consequently, no tendency for the blank to cock or rock when the cutter starts to recede, and being mechanically removed from the blank and because the finger does not snap off, there is no marking of the shank. This new construction is shown in Fig. 4.

✦ ✦ ✦

ON solid die work great pressure is necessary to start the ejection of the piece from the die. If the ejector pin applies this pressure suddenly it causes more or less of a blow, which upsets the end of the blank. Naturally, this upsetting of the end of the blank results in a scored die as the piece is ejected. To eliminate this difficulty an accelerated cam action was devised, which applies pressure gradually to the kickout pin and gives a slow initial starting movement. After the blank has started to move out of the die the pressure, of course, gradually diminishes and the movement of the new type ejector is gradually accelerated. Thus, the piece is ejected with push rather than a blow and there is no serious upsetting of the end or scoring of the die due to ejection. This new kickout arrangement is pictured in Fig. 5.

✦ ✦ ✦

SOME idea of the practical results of these improvements may be gained by an examination of the sample operations shown in

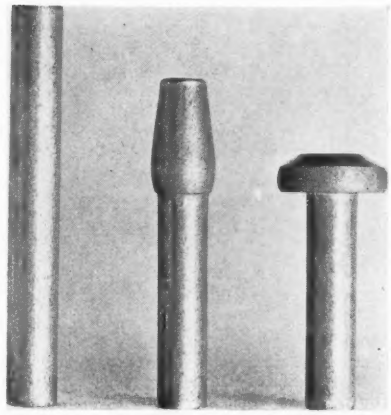

Fig. 6.

Fig. 6. Note that the blanks are free from score marks and that the upsets are central and uniformly filled.

✦ ✦ ✦

A CONSTANT source of annoyance and production delay in the past has been the crop end of each coil. After the end of the coil has passed the feed rolls there was nothing that could be done except shut down the machine and remove this crop end and discard it as scrap. If an attempt was made to feed this crop end into the machine by means of the starting end of the new coil, then, because a portion of the feed travel occurred before the new coil started to advance the crop end, the wire would not travel entirely to the gauge. As a result, a short blank would be sheared off and would stick in the

(*Please turn to Page 501*)

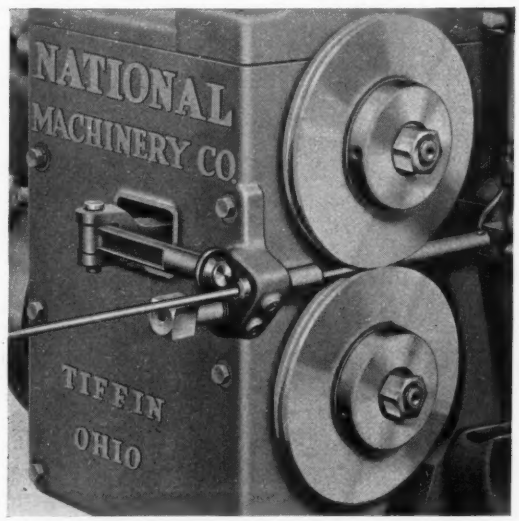


Fig. 7.

✦ ✦ ✦ ✦ ✦

# All Wire Mill Men Are Invited to Attend The Wire Association 1937 Meeting and Exhibition

## At Atlantic City, N. J., October 18, 19, 20, 21, 22, 1937

### In Association With the National Metal Congress

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JOHN C. CALLAGHAN
Works Manager, Canada Works, Steel Co. of Canada. Chairman, Program Committee.

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Wm. H. Bassett, Jr., Manager, Metallurgical Development, Anaconda Wire & Cable Co., Hastings-On-Hudson, N. Y.

H. B. Carnahan, Asst. Works Mgr., Canada Wire & Cable Co., Ltd., Toronto, Ont., Canada.

L. E. Dunkelberger, Chief Engineer, Reynolds Wire Company, Dixon, Ill.

D. Horsfall, Works Manager, Canada Wire & Cable Co., Ltd., Toronto, Ontario, Canada.

Carl Rolle, Mechanical Engineer, International Nickel Co., Inc., New York, N. Y.

B. L. McCarthy, Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.

R. E. Brown, President, "WIRE AND WIRE PRODUCTS." New York, N. Y.

#### Steel and Ferro Alloys Division

F. A. Westphal, Supt., Wire Mills, Sheffield Steel Corp., Kansas City, Mo. Chairman of Division

A. F. Anjesky, Sales Manager, Cleveland Tramrail Div. of the Cleveland Crane & Engr'g. Co., Wickliffe, Ohio

L. Atkinson, Superintendent, Frost Steel & Wire Co., Ltd., Hamilton, Ontario, Canada.

Rodman R. Tatnall, Engineer, Wickwire Spencer Steel Co., Worcester, Mass.

Earle H. Thomas, Superintendent, Geo. W. Prentiss & Co., Holyoke, Mass.

Leslie C. Whitney, Chief Metallurgist, Copperweld Steel Corp., Glassport, Pa.

Make Your Plans Now to Come and Participate in the Discussions.
For detailed information address RICHARD E. BROWN, Secretary

17 EAST 42nd ST. **THE WIRE ASSOCIATION** New York, N. Y.

# ✣ PROGRAM ✣

## Monday, October 18, 1937 at Hotel Ambassador, Atlantic City, N. J.

**A. M.—Registration—"Get Together"**
**1 P. M. Directors' Meeting—Program Committee Meeting and Lunch**

✦ ✦ ✦

# The Technical Sessions

**MONDAY, TUESDAY, WEDNESDAY AND THURSDAY, OCTOBER 18-19-20-21, 1937**

**(All Research Papers Will Be Preprinted in the October Issue of Wire and Wire Products)**

---

**THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THESE TECHNICAL SESSIONS AND INFORMAL MEETINGS**

**ADMISSION WILL BE BY BADGE ONLY**

**To those Registering and Attending the Meetings stenographic copies of the discussions will be available free. To all others $5.00 per copy**

**MONDAY, OCTOBER 18, 1937**
**Afternoon Session, 2:00 P. M.**

**PAPER: FATIGUE PROPERTIES OF HELICAL SPRINGS**
**By R. R. Tatnall, Engineer,**
**Morgan Works, Wickwire Spencer Steel Co., Worcester, Mass.**

✦ ✦ ✦

**TUESDAY, OCTOBER 19, 1937**
**Morning Session, 9:30 A. M.**

**PAPER: NEW DEVELOPMENTS IN MATERIAL HANDLING FOR WIRE MILLS**
**By A. F. Anjeskey, Sales Manager**
**Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio**

**PAPER: NOTES ON THE ANNEALING OF NICKEL SILVER WIRE IN COILS**
**By T. C. Merriman, Metallurgist**
**Seymour Manufacturing Co., Seymour, Conn.**

**MOTION PICTURE: "THE MAKING OF STEEL WIRE," BETHLEHEM STEEL CO.**

**Afternoon Session, 2:00 P. M.**

**PAPER: LIME IN WIRE DRAWING**
**By D. E. Washburn, Chief Chemist**
**American Lime & Stone Div. of Warner Co., Bellefonte, Pa.**

**PAPER: A. C. ELECTRO-PICKLING**
**By Allan B. Dove, Chemical Engineer**
**Canada Works, The Steel Company of Canada, Ltd., Hamilton, Ont., Canada**

**PAPER: HANDLING WASTE ACIDS FROM PICKLING OPERATIONS**
**By H. E. Klein, Engineer, Chemical Industry**
**B. F. Goodrich Company, Akron, Ohio**

✦ ✦ ✦

**WEDNESDAY, OCTOBER 20, 1937**

**Simultaneous Meetings of Ferrous and Non-Ferrous Divisions All Day**
**Morning Sessions, 9:30 A. M.**

**Ferrous Division**

**PAPER: COLD HEADING**
**By L. S. Cooch, Metallurgist**
**Buffalo Bolt Company, North Tonawanda, N. Y.**

PAPER: THE ART OF COLD HEADING, PAST, PRESENT AND FUTURE
By A. R. Ryan, Industrial Engineer
General Electric Co., Schenectady, N. Y.

### Non-Ferrous Division

PAPER: PRODUCTION OF COPPER FROM MINE TO MILL
By Wm. H. Bassett, Jr., Manager, Metallurgical Development
Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y.

MOTION PICTURE: NORANDA ENTERPRISES

✦ ✦ ✦

Afternoon Sessions, 2:00 P. M.

### Ferrous Division

PAPER: THE PHENOMENON OF GRAIN GROWTH IN LOW CARBON STEEL WIRE
By B. L. McCarthy, Chief Metallurgist
Wickwire Spencer Steel Company, Buffalo, N. Y.

### Non-Ferrous Division

PAPER: THE MANUFACTURE OF FOURDRINIER WIRES
By Hugh E. Brown, Director of Research
W. S. Tyler Company, Cleveland, Ohio

PAPER: THE NEED OF A BETTER QUALITY OF COPPER IN APPARATUS MANUFACTURE
By L. H. Burnham, Engineer
Transportation Div., General Electric Company, Pittsfield, Mass.

At 4:30 P. M., Wednesday afternoon all Technical Sessions will terminate for the day and be immediately followed by the annual meeting of the Wire Association. At this meeting will be made the Award of The Wire Association Medal, by John C. Callaghan, Chairman of Program Committee.

✦ ✦ ✦

Evening—The Ambassador—7:30 P. M.
Annual Dinner—Stag-Smoker

DINNER COMMITTEE

R. L. Hamaker, Dist. Sales Manager
Warner Company
New York, N. Y.
Chairman

A. R. Zapp, Manager
Firthaloy Division
Firth Sterling Steel Co.
McKeesport, Pa.

✦ ✦ ✦

THURSDAY, OCTOBER 21, 1937

Morning Session, 10:00 A. M.

PAPER: A METALLURGICAL STUDY OF THE FACTORS AFFECTING THE QUALITY OF GALVANIZING
By R. W. Sandelin, Chief Metallurgist
Atlantic Steel Company, Atlanta, Ga.

PAPER: HIGH NICKEL ALLOYS IN THE FIELD OF WIRE AND WIRE PRODUCTS
By Carl Rolle, Development and Research Division
International Nickel Co. Inc., New York, N. Y.

Afternoon Session, 2:00 P. M.

PAPER: COLD DRAWN BARS
By D. W. McDowell, Metallurgist
Union Drawn Steel Company, Chicago, Illinois

PAPER: PRODUCTION OF BOLTS FOR RAILROADS AND BRIDGES
By Chas. Fassinger, Vice-President
Oliver Iron & Steel Corp., Pittsburgh, Pa.

MOTION PICTURE: "THE MAKING OF STEEL WIRE," BETHLEHEM STEEL CO.

ALL MEETINGS WILL BE HELD AT THE AMBASSADOR HOTEL, ATLANTIC CITY, N. J.

# Exports and Imports of Wire

**Exports of Iron and Steel Wire Products in June, 1937, and June, 1936**
**(In Gross Tons)**

| | JUNE 1937 | MAY 1937 | JUNE 1936 |
|---|---|---|---|
| Wire rods | 3,968 | 5,872 | 3,317 |
| Strip steel | 10,300 | 8,077 | 6,002 |
| Plain, black or galvanized iron or steel wire | 4,591 | 5,675 | 4,069 |
| Barbed wire and woven wire fencing | 3,009 | 4,086 | 2,187 |
| Woven wire screen cloth | 143 | 182 | 94 |
| Wire rope | 517 | 416 | ..... |
| Insulated iron or steel wire and cable—see analysis below | | | |
| Other wire and manufactures | 1,355 | 850 | 399 |
| Wire nails | 1,966 | 1,980 | 448 |
| Tacks | 24 | 22 | 32 |
| Other nails, including staples | 217 | 256 | 149 |
| Bolts, machine screws, nuts, rivets and washers | 1,019 | 1,321 | 493 |
| Total, these 11 classifications | 27,109 | 28,737 | 17,190 |

**Imports of Iron and Steel Wire into the United States**
**(In Gross Tons)**

| | | | |
|---|---|---|---|
| Concrete reinforcement bars | 40 | 771 | 501 |
| Hollow bar and drill steel | 230 | 273 | 162 |
| Wire rods | 1,044 | 1,293 | 1,278 |
| Barbed wire | 580 | 962 | 557 |
| Round iron and steel wire | 308 | 484 | 420 |
| Telephone and telegraph wire | 2 | ..... | 1 |
| Flat wire and strip steel | 350 | 366 | 274 |
| Other wire | 734 | 428 | 64 |
| Hoops and bands | 2,674 | 2,393 | 979 |
| Nails, tacks and staples | 810 | 1,159 | 1,479 |
| Bolts, nuts and rivets | 18 | 16 | 16 |
| Total, these 12 classifications | 6,790 | 8,145 | 5,731 |

**Exports of Insulated Wire and Cable, June, 1937**

| | Foreign | | To U. S. Possessions | |
|---|---|---|---|---|
| | Pounds | Dollars | Pounds | Dollars |
| Insulated iron or steel wire and cable | 8,402 | $ 2,595 | 1,568 | $ 216 |
| Rubber-covered wire | 572,398 | 170,363 | 93,039 | 24,622 |
| Copper weatherproof wire | 156,994 | 34,887 | 15,824 | 4,183 |
| Copper telephone cable | 20,263 | 4,592 | 1,440 | 338 |
| Other insulated copper wire | 507,542 | 135,375 | 319,742 | 57,102 |
| Nickel-chrome electric resistance wire | 41,883 | 43,593 | ..... | ..... |
| Total, these 6 classifications | 1,307,482 | $391,405 | 431,613 | $86,461 |

## Pig Iron Shipments Lower in May

IN June, pig iron exports recorded the outstanding decline (12,404 tons) when compared with the total for May, others of moment occurring in ingots (5,634 tons), tin plate (5,207 tons), heavy rails (4,338 tons), wire rods (1,904 tons), and skelp (1,688 tons). The most prominent increase (5,847 tons) was registered in exports of unfabricated plate, followed by those in plain shapes (2,946 tons), galvanized sheets (1,839 tons), hot-rolled strip steel (1,818 tons), relaying rails (1,498 tons) and black steel sheets (1,282 tons).

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## Pig Iron Continues Leading Export Item

FROM a tonnage standpoint, pig iron shipments totaling 105,194 tons (117,598 tons in May) represented the leading export item, the outstanding markets being Japan (60,086), the United Kingdom (4,781), Sweden (3,640), and Poland (1,048). Next came unfabricated plate shipped to an aggregate of 31,485 tons (25,738 tons) mostly to Japan (11,110), Canada (4,274), Sweden (4,241), China (1,973), and Soviet Russia (1,176). Following were black steel sheets 25,029 tons (23,747 tons) going chiefly to Canada (6,972), Soviet Russia (3,732), Mexico (2,428), France (2,162), and China (1,590). Tin plate followed in a trade aggregating 23,207 tons (28,414 tons), the most prominent outlets being Japan (3,095), Cuba (2,405), China (1,714), the Netherlands (1,710), Brazil (1,618), and Italy (1,550). Next were ingots totaling 19,753 tons (25,387 tons) taken mostly by Japan (16,788), China (1,108), and Mexico (560). Sixth in importance were steel bars 12,760 tons (12,954 tons), the bulk taken by Canada (2,239), Colombia (1,887), China (1,775), the Philippine Islands (641), and Turkey (544).

✦ ✦ ✦

## Far East Again Leading Outlet

RANKING first as an outlet for United States semi-finished and finished iron and steel products for the fourth consecutive month, the Far East took 138,215 tons in accounting for 45.1 percent of the shipments made in June (45.8 percent in May). Following was Europe whose purchases (71,220 tons) accounted for 23.2 percent (21.6 percent). Next was North and Central America and the West Indies (62,435 tons) whose proportion of 20.4 percent was followed by South America's total (28,127 tons) which made up 9.2 percent. Last was Africa's receivings (6,284 tons) which was only 2.1 percent (2.0) of all shipments made during the month.

✦ ✦ ✦

## Japan Continues Leading Individual Outlet

FOR the second successive month, Japan led Canada as an outlet and accounted for 96,259 tons of chiefly pig iron (60,086), steel ingots (16,788), unfabricated plate (11,110), tin plate (3,095), and wire rods (1,012). Next came Canada (38,474 tons) whose trade was mostly skelp (8,319), black steel sheets (6,972), plain shapes (4,925), unfabricated plate (4,274), cold-rolled strip steel (3,072), steel bars (3,072), and hot-rolled strip steel (1,345). Following was the United Kingdom (34,951 tons) in a trade chiefly of pig iron (31,624), steel bars (595), hot-rolled strip steel (550), and black steel sheets (503). China's total (16,622 tons) — fourth in importance — was chiefly pig iron (4,781), unfabricated plate (1,973), steel bars (1,775, tin plate (1,714), black steel sheets (1,590), and steel ingots (1,108). Mexico took 10,284 tons, of which the bulk was black

steel sheets (2,428), tin plate (1,034), car wheels and axles (785), seamless casing and oil-line pipe (627), steel ingots (560), and welded black steel pipe (517). Sweden was sixth in a trade aggregating 10,256 tons, the bulk being unfabricated plate (4,241), pig iron (3,640), plain shapes (796), tin plate (615), and black steel sheets (483).

✦ ✦ ✦

### But Slight Change in Imports

DESPITE the fact that the iron and steel export trade of the United States has registered a steady increase, imports have recorded but little change over last year. In fact, the June trade (39,699 tons valued at $2,212,086) was slightly lower than in May (39,788 tons valued ot $2,271,192), and also below the June 1936 total (40,325 tons valued at $1,657,194). Compared with May, receipts in June recorded declines in 17 items, gains in a like number, and in 5 products there was no trade in either month. The sharpest decline (1,988 tons) was that in 'other' pipe receipts, followed by those in shapes (1,602 tons), sheets, skelp and sawplate (852 tons), and concrete reinforcing bars (731 tons). The outstanding increase registered (1,588 tons) was in spiegeleisen, others of moment occurring in pig iron (1,180 tons), rails (1,126 tons), and ferromanganese (991 tons).

✦ ✦ ✦

### Pig Iron Leads in June

PIG iron in a trade totaling 7,541 tons was the principal product received in June—from the standpoint of tonnage—and came mostly from British India (6,810), Canada (381), and Sweden (200). Then came shapes (7,380 tons) taken chiefly from Belgium (6,053), and France (1,297). Following were solid and hollow bars (3,635 tons) principally from Belgium (2,616), France (423), and Sweden (422). Ferromanganese was next (3,418 tons) and the bulk came from Norway (2,181), and Canada (1,082). Then were 'other' hoops and bands (2,674 tons) coming chiefly from Belgium (1,868), France (668), and Germany (114). Sixth was spiegeleisen (2,375 tons), coming from Canada (2,325), and Norway (50).

✦ ✦ ✦

### Again Belgium Leads as Supplier

BELGIUM continued in June to lead in the supply of iron and steel products (excluding scrap) to the United States. Its total (11,703 tons) consisted of chiefly shapes (6,053), solid and hollow bars (2,616), and 'other' hoops and bands (1,868). Second was British India (6,810 tons) whose trade was all pig iron. Germany (6,082 tons) followed and the bulk of its trade was in 'other' pipe (1,631), rails (904), sheet piling (671), nails, tacks, and staples (603), and barbed wire (532). Canada's total (4,986) ranked next and included chiefly spiegeleisen (2,325), ferromanganese (1,082), and rails (757). Fifth came Sweden (3,566 tons) whose trade was mostly wire rods (993), solid and hollow bars (322), sponge iron (371), flat wire

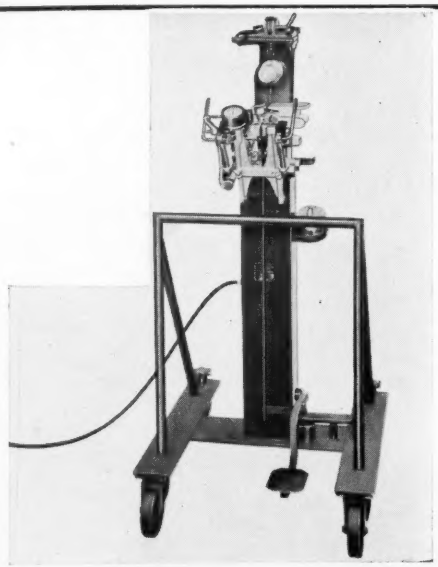
(*Please turn to Page 504*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

CONTINUOUS IMPROVEMENT

MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



MICRO PRODUCTS COMPANY

20 NORTH WACKER DRIVE, CHICAGO, ILL.

Telephone State 7468 General Office and Factory, Peoria, Ills.

# A Review of Recent Wire Patents

No. 2,085,780, METHOD OF MAKING FROZEN STRIPS OF WIRE STAPLES, Patented July 6, 1937 by Rudolph E. Zeruneith, Camden, N. J.

In addition to wire staples, it is stated that this method is adapted for making strips of wire hairpins of the type of either wire staples or wire hairpins which are removably secured together by a suitable adhesive.

✦ ✦ ✦

No. 2,085,957, COIL WINDING MACHINE, Patented July 6, 1937 by Edward W. Collins, Anderson, Ind., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware.

This is described as an improvement over U. S. patent 1,995,916 of March 26, 1935, the inventor having provided means in the machine to prevent accidental manipulation of the foot pedal during winding operations.

✦ ✦ ✦

No. 2,085,995, INSULATED ELECTRICAL CONDUCTOR AND PROCESS OF MAKING SAME, Patented July 6, 1937 by Winton I. Patnode and Edward J. Flynn, Schenectady, N. Y., assignors to General Electric Company, a corporation of New York.

For the purpose of providing a hard, flexible, tough abrasion-resistant insulation for wire conductors, these inventors provide an organic insulation comprising the products of reaction of formaldehyde and hydrolyzed polymerized vinyl acetate.

**Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.**

✦ ✦ ✦

No. 2,086,012, SPRING STRUCTURE, Patented July 6, 1937 by William E. Wunderlich, Muncie, Indiana.

The spring structure is one where compression springs and a number of helical springs are included, the latter extending transversely of the rows of compression springs, with the material forming the ends of the helical springs being deformed to provide tongues and project between the overlapping portions of the end turns of adjacent compression springs to hold the end turns together.

✦ ✦ ✦

No. 2,086,086, FASTENER SEAL, Patented July 6, 1937, by Raoul Lassonde, St. Hyacinthe, Quebec, Canada.

This nail has a bulbous enlargement formed adjacent the head and independent thereof with a ring of relatively soft material having a flaring peripheral skirt portion and a tubular sleeve adapted to be tightly fitted about the enlarged portion of the nail.

✦ ✦ ✦

No. 2,086,248, WEFT LAYING MECHANISM FOR A WIRE CLOTH LOOM, Patented July 6, 1937 by Herbert L. Thompson, Elgin, Ill., assignor to Reynolds Wire Co., Dixon, Ill., a corporation of Illinois.

The mechanism includes a rolling shuttle with means for projecting it through the warp shed for laying the weft wires and thereafter conveying it on a curved path to a position substantially in the weaving line.

✦ ✦ ✦

No. 2,086,321, SPRING, Patented July 6, 1937 by Hiojiro Kudo, Nada-ku, Kobe, Japan, assignor to The Kobe Seikosho Company, Limited, Kobe City, Japan.

In this construction, there are two wire springs, one of generally cylindrical cross section and inner one of conical cross section, screwed one into the other and in contact with each other at one end and diverging towards the other end.

✦ ✦ ✦

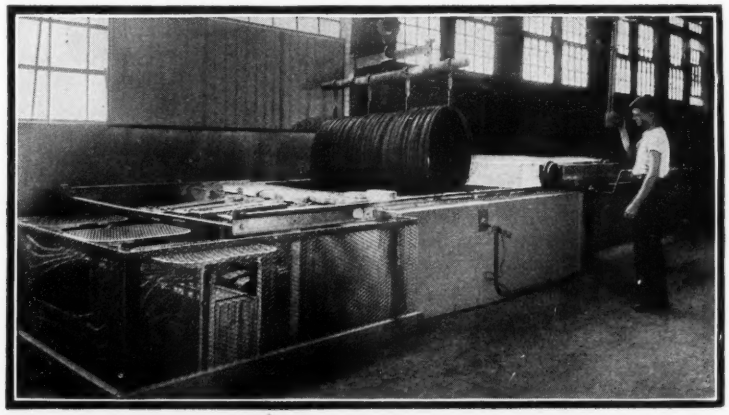
No. 2,086,736, ROD BENDING MACHINE, Patented July 13, 1937 by Robert Kendrick Palmer, Hamilton, Ontario, Canada.

*(Please Turn to Page 490)*


# LAVITE ANNEALING

GIVES — more uniform product — greater output — lower cost — better surface — eliminates pickle — better shop conditions — no excess heat; no dirt; no smoke.

RESULTS — of years of development of materials, processes and equipment as covered by our patents of many new and exclusive features.



LAVITE ANNEALING FURNACE—1000°—2000° F.

**THE BELLIS HEAT TREATING CO.**
Branford
Connecticut

and

LAVITE LIMITED,
Low Moor, Bradford
Yorks, England

# A Review of Recent Wire Patents

*(Continued from Page 489)*

This machine is adapted for simultaneously effecting a number of bends in a straight rod, the position of the bends being adjusted by the machine.

✦ ✦ ✦

No. 2,086,801, PROCESS OF MAKING TAPPET SCREWS, Patented July 13, 1937 by Howard A. Hayden, Detroit, Michigan.

This screw comprises a hard wearing portion supported in a softer and tougher portion.

No. 2,087,303, INSULATED CONDUCTOR AND METHOD OF MAKING SAME, Patented July 20, 1937 by Samuel J. Rosch, Yonkers, and Vito F. di Lustro, Irvington, N. Y., and Paul M. Rogers, Orange, Calif., assignors to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

More specifically, the invention lies in the provision of the covering for wire conductors which covering comprises an elongated mass of loosely associated carded fibres of low inherent tensile strength with a helical thread-like reinforcement about the exterior thereof.

✦ ✦ ✦

No. 2,087,335, STRAND MEASURING APPARATUS, Patented July 20, 1937 by George A. Seeley, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

This apparatus is adapted for measuring unevenly surface wire from processing machines as the wire is advanced to a takeup reel.

✦ ✦ ✦

No. 2,087,876, ANNULAR STRAND, Patented July 20, 1937 by Thomas F. Peterson, Worcester, Mass., assignor to The American Steel and Wire Company of New Jersey, a corporation of N. J.

This strand is adapted for use as an electrical conductor and is without internal supporting members.

✦ ✦ ✦

No. 2,087,881, FASTENING, Patented July 27, 1937 by Edward H. Bastable, Jamaica Plain, Mass., assignor to United Shoe Machinery Corporation, Paterson, N. J., a corporation of New Jersey.

For the purpose of securing, temporarily, a heel to the heel-seat of a shoe, this inventor has provided a screw-like fastening means, including a head, a shoulder, a cylindrical hub, with the shoulder inclined gradually toward the hub, the hub having at its inner end a flat shoulder of less diameter than the inclined shoulder, and the fastening terminating in a threaded shank.

✦ ✦ ✦

No. 2,088,176, METHOD OF AND MEANS FOR COVERING WIRE, Patented July 27, 1937 by Paul M. Rogers, Hastings on Hudson, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

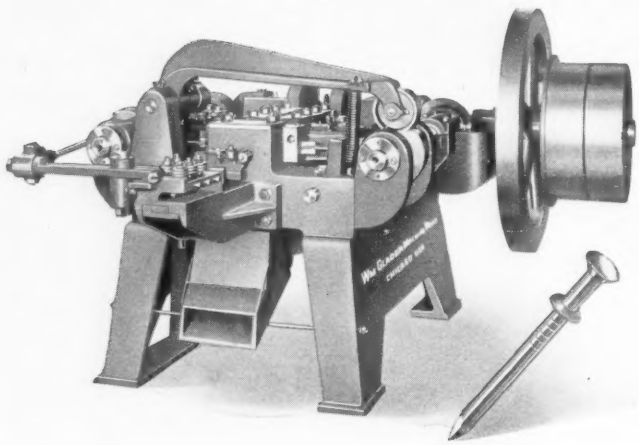
In this patent, the method includes disintegrating stock to form flock, pneumatically compressing the flock into a strip-like mass while assembling a reinforcement therewith and wrapping such strip and reinforcement simultaneously around a longitudinally advancing core.

✦ ✦ ✦

No. 2,088,446, METHOD OF PRODUCING COVERED WIRE, Patented July 27, 1937 by Harry G. Specht, Montclair, N. J., assignor to Eastwood-Nealley Corporation, Belleville, N. J., a corporation of N. J.

The process consists in simultaneously feeding between feeding rolls a flat covering strip, a flat strip of bonding material, and a separate wire core in longitudinal juxtaposition, the flat strip of bonding material being in engagement with the core, then feeding the strips and core through a succession of longitudinally spaced circular forming dies of gradually decreasing diameter to form the covering strip and bonding strip from flat to tubular form about the core, the edges of the covering and bonding strips extending longitudinally of the core, and subjecting the covered wire to a heating operation at a point between the first and last dies to cause the bonding strip to bond the covering strip to the wire core.


GLADER WIRE NAIL MACHINERY



We Have Recently Made An Addition To Our Line Of Wire Nail Making Machinery.

The Machine Illustrated Above Produces The "Duplex" or Twin-Head Wire Nails.

*For Further Information Address*

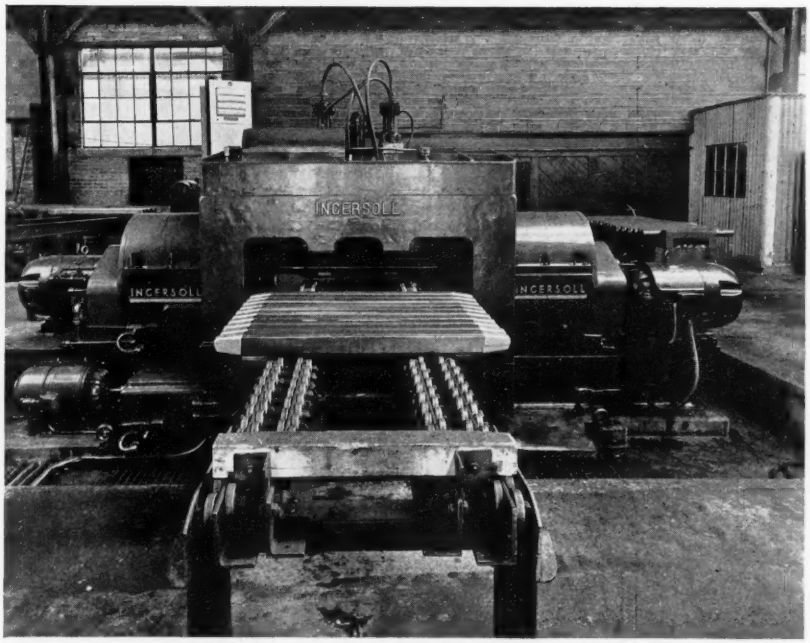
**WM. GLADER MACHINE WORKS**

210 N. Racine Avenue,

CHICAGO, ILLINOIS

# New Double Pointed Vertically Cast Wire Bar

By Frederic Benard,
Plant Manager, Ontario Refining Company Ltd., Copper Cliff, Ontario.




IN the development of production technique for the manufacture of vertically cast copper wire bars, a great deal of time and effort has been expended in devising a method of providing these bars with a tapered nose at each end. This is a standard design feature of the familiar horizontally cast wire bar and owes its importance to the fact that unless a well rounded, tapered nose is provided, there is inevitably over-rolling and "fish-tailing" in the breakdown passes of the rolling mill, which leads to excessive scrap.

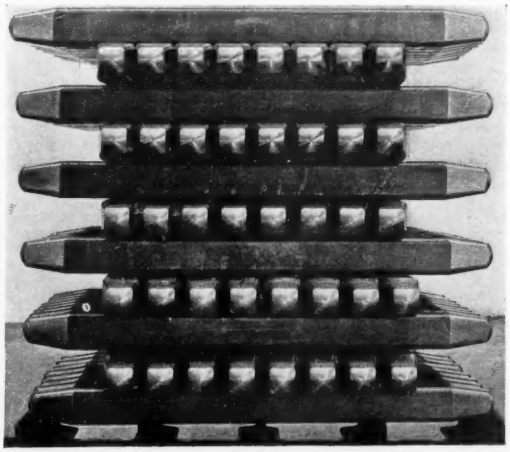
✦ ✦ ✦

MANY methods have been investigated for securing this necessary nose at each end of the vertically cast product. These include as the essential mechanism, rolling, swaging, and casting. Recently, the Ontario Refining Company, Copper Cliff, Ont., in cooperation with Ingersoll Milling Machine Co., Rockford, Illinois, has successfully developed a production machine for machining a nose on both ends of a vertically cast copper wire bar. By this process a scientifically designed nose is secured which represents the ideal section from the standpoint of minimized end scrap in rolling operations.

✦ ✦ ✦

PRODUCTION rolling of the new double pointed bar has recently afforded full confirmation of results secured in experimental tests. Rod produced from these bars is superior in quality, especially in the production of hair wire, to that resulting from reduction of the horizontal type being characterized by freedom from laps, slivers and oxide segregation. It also possesses definite advantages over rod rolled from the regular style vertically cast bar with square cut ends and taper at one end only. These features result in over-rolling with its attendant evils necessitating removal of considerable end scrap. The rounded contour of the new bar is advanced with successive reductions, thus eliminating the familiar "fish-tail" effect.

✦ ✦ ✦



Vertically cast copper wire bars with tapered nose at each end.

THE ingenious machine which performs the pointing operation consists substantially of two three-spindle motor driven saddles mounted on bedways on opposite sides of a work holding fixture. Each saddle contains a rotating drum having two spindle carriers arranged to move in arcs of a circle having the drum axis for a diameter.

✦ ✦ ✦

THE machine cycle is as follows: Bars are deliver-

(*Please turn to Page 495*)

# 'Round the World With the Wire Industry

### German Notes

ALTHOUGH the usual summer lull is on, the wire industry has so many unfilled orders on the books that there is no slowing down of operations. Quite on the contrary, German wire production is wholly inadequate to the demand. German wire production rose as follows: (monthly average); first half of 1932 (the lowest after war year figure) 32,000 tons; 1933, 37,000 tons; 1934, 49,000; 1935, 68,000 tons; 1936, 86,000 tons, and this year, 93,000 tons. A further rise without expansion of plants is impossible (except a small correction of this figure upwards). But the demand is growing rapidly and the consumers are retarded on getting deliveries. The wire industry got only about 75% of its wire rod requirements first half of 1937. The domestic customers got about 80% of their orders accepted; the export customers less than two-thirds. As a very heavy demand is anticipated for the autumn months, it will be difficult to place the orders inasmuch as the other continental wire makers are in about the same position as the German makers. No change of prices has occurred in the past weeks.

✦ ✦ ✦

GERMAN copper wire exports advanced from 1,788 tons the first half of 1935 to 1,987 tons last year and 2,748 tons first half of 1937. Twisted copper wire (3 to 7 ply) advanced from 640 tons to 1,386 tons. The values were up for wire by 63% and for twisted copper wire by 168%.

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ALL stocks of wire and wire products in hands of the German trade exceeding 10 tons had to be reported to the Directors of the iron and steel industry supervision office in Berlin up to July 17th.

✦ ✦ ✦

FOLLOWING the reduction of aluminum prices in Germany, the prices for aluminum cables and electric wires were reduced 10% on July 5th. The export prices however have been left unaltered and are higher now than the domestic quotations.

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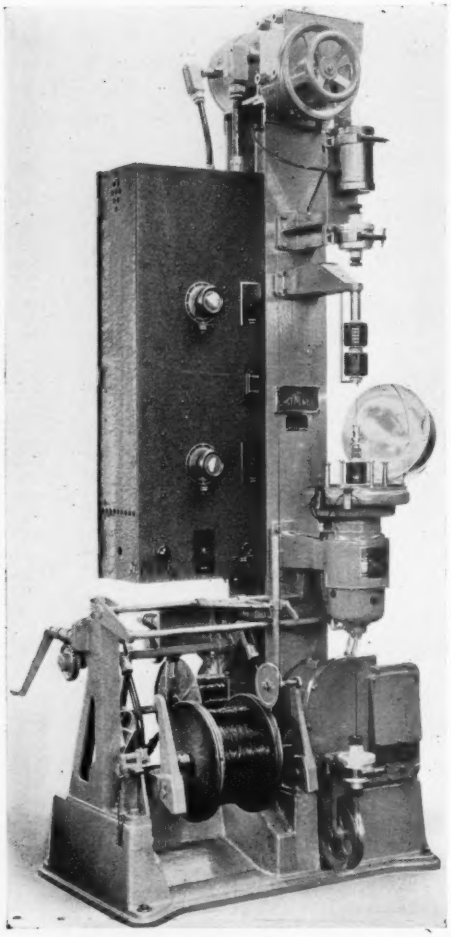
THE shipment dates as quoted by the IWECO for export are as follows: Wire nails, smooth specification, 10 to 12 weeks, including odd sizes or broken specifications 12 to 15 weeks; barbed wire 8 to 10 weeks; fencing wire 10 to 12 weeks; manufacturers bright wire 14 to 16 weeks; annealed wire 7 to 9 weeks; wire netting up to 20 weeks, twisted (3 to 7 ply) wire 14 to 16 weeks. The shipment dates for high quality steel wire (not under control of the IWECO) are up to 20 weeks and


SYNCRO



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CONVENTION

BOOTH F - 2

**SYNCRO MACHINE COMPANY**

187 SYLVAN AVE. NEWARK, N. J.

# 'Round the World With the Wire Industry

for wire ropes between 12 and 16 weeks.

✦ ✦ ✦

LAST year 15 to 20% of German wire rod exports were o.h. steel quality; at present however, the percentage has risen above 50%.

✦ ✦ ✦

### Wire in the Philippines

A SMALL amount of Japanese plain wire is being sold in the **Philippine** market. No barbed wire and nails, however, are being offered by that source. Nor is European barbed wire being offered in the market, but there appears to be fairly substantial stocks on hand. Nails are being offered by producers in The Netherlands and for the 1-inch size their prices shave (some 10 percent) those offered by American shippers; however, with respect to the larger sizes the prices quoted are approximately the same.

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### More Fences for Buenos Aires

PROPERTY owners in Buenos Aires, **Argentina,** are "hastening to erect fences and sidewalks in order to avoid penalty payments," because of two municipal laws issued recently. Most of the fence installations are of wire partially processed and meshed in local mills. In the first 5 months of the current year the United States is reported to have sold to Argentina some 3,535 tons of plain, galvanized and barbed wire.

✦ ✦ ✦

### High Wire Demand at Hamilton

THE wire plants of the steel companies in the Hamilton, Ontario, district of **Canada** "are busy supplying the demand for wire products". Wire output has increased, owing to an augmented demand for wire to "make wire rope and wire for automobile tires." Steel bar orders are sufficient to keep the bar production departments active for at least three months, while orders on hand for steel sheets and tin plate are expected to keep the plants busy until January 1938. Scrap demand is heavy. Practically all iron and steel companies in the district anticipate an excellent year it is stated.

✦ ✦ ✦

### Bar Competition in Philippines

EUROPEAN quotations in the **Philippine Islands** for concrete reinforcement bars are approximately the same as those offered by American suppliers, but that deliveries are longer delayed. European mills are apparently making some effort to become competitive in bars, and deliveries are stated to be improving.

✦ ✦ ✦

### Confirms Sale to Bethlehem Of Williamsport Wire Rope

AN order confirming the sale of Williamsport Wire Rope Co., Williamsport, Pa., to Bethlehem Steel Co. for $3,300,000 was signed recently by federal judge Albert W. Johnson at Lewisburg, Pa.

**FARREL NI-HARD ROLLS**
PRODUCE BETTER FINISH SHEETS

The surface of rolled sheets can be no better than the surface of the rolls on which the sheets are produced. Farrel Ni-Hard Rolls are ideal for high finish sheets as they produce a higher quality finish, their life is longer and cost per ton of output is lower. Farrel Ni-Hard Rolls combine a hardness of 80 to 90 scleroscope with high strength and a flawless surface. Note the highly reflective surface of the Farrel Ni-Hard Rolls shown in the unretouched photograph above.

Farrel Rolls are made in several grades, including Sand, Cupola Chilled Iron, Electric Furnace Chilled Alloy Iron, Heat-Treated Farrel Ni-Hard, Farrel-Erler and Steel.

Over seventy-five years' experience in designing and manufacturing rolls for a broad variety of uses . . . unexcelled plant facilities . . . modern equipment . . . skilled technicians in metallurgy and engineering . . . founders and machinists trained in specialized roll manufacture . . . make an effective combination for producing rolls of superior quality, precision and durability.

**Farrel-Birmingham Rolling Mill Equipment includes:** Rolls — Rolling Mills — Rod Mill Tables and Manipulating Equipment — Universal Mill Spindles —Rod Coilers — Lead Presses for Pipe or Rod — Roll Grinding Machines — Roll Calipers — Gears — Mill Pinions — Pinion Stands — Drives up to 10,000 H.P. — Flexible Couplings.

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Whatever your use of wet drawn or tinned wire, Continental can supply you the desired color, character and weight of finish on base wire of analysis and temper to speed your production, reduce rejections, and add to the appearance and dependability of your product. Liquor finished and coppered in hard, soft, and special stapling; white bronze, extra coppered, and extra liquor finished in hard and soft; liquor drawn bright annealed, dead soft annealed copper wiped, and annealed cleaned copper dipped; also tinned wire, are among those available. Prompt, dependable service on these or any types of manufacturers wire. We invite your inquiries.

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## Recent Studies of Intergranular Corrosion in Nickel-Chrome Steels

(*Continued from Page 473*)

quenched bar. We must simply remember that the precipitation of carbide, intensified by cold work after quenching, may in some cases give rise to an exceptional tendency to submit to intergranular corrosion.

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### Summary


WHATEVER the composition of the austenite, its content of nickel, chrome, carbon, etc., whatever the alloy, whether 18/8, NC4, ATV, etc., and whether the corrosive medium be Strauss' reagent, steam, sulphurous liquors, etc., the mechanism of localized corrosion seems to be the same. Carbide grains precipitate, and each is surrounded by an envelope lean in chromium and chemically vulnerable.

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WHETHER it is intergranular corrosion affecting all grains, or fissuring along cracks, the attack is conditioned by a number of factors; composition of the alloy, amplitude and extent of the heterogeneity, selective action of the reagent, cold work, strains, both internal and external in origin, etc. Hence these various effects: NC4, sensitive to steam, is resistant to Strauss' reagent; in the same reagent 18/8 is resistant when quenched; ATV similarly treated yields to sulphurous liquors, etc.

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IT is impossible to draw inferences from experience with one reagent that are valid with another. Particularly in matters relating to corrosion by steam, experience is the only safe guide. Experience shows that ATV, however treated, resists steam perfectly, proof that the impoverished areas are resistant simply by virtue of their high nickel content.

✦ ✦ ✦

ONE outstanding fact in this study is the danger of rendering the chrome-nickel alloys sensitive by cold work even with no subsequent temper. This should lead to greater precaution in specifying the austenitic stainless

steels, and in trusting too far a chemical stability resulting from a quench. Not only is it difficult to quench large pieces uniformly but it is equally difficult to avoid absolutely local work hardening which may nullify the effect of a quench.

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IT would seem wise to double the chances of success by backing up heat treatment by a chemical composition inherently resistant. For turbine blades, recent discoveries confirm the beliefs long held, that heavy doses of both nickel and chromium are in the direction of sound practice.

✦ ✦ ✦

### New Double Pointed Vertically Cast Wire Bar

(*Continued from Page 491*)

ed by a conveyor to the loading side. The operator guides the bar into a loading vee and presses a button. Hydraulic cylinders raise a clamp off the preceding bar, now finished, and the fixture platen rises lifting rough bar out of loading vees and finished bar from clamping vees. The platen then moves forward, delivering finished bar onto a discharge conveyor and locates the rough bar in the clamping vees. Hydraulic cylinders lower a clamp onto the rough bar and fixture piston drops and returns to starting position. The saddles now approach quickly and cutters are fed to depth, the combination of drum rotation synchronized with spindle carrier movements and saddle feed generate the special nose form. At the end of the feed stroke, saddles make quick return to starting position and operator pushes button to repeat cycle. Thus all operations are automatic after the bar is placed in loading vees and the starting button pressed. The total time for the cycle is approximately 60 seconds.

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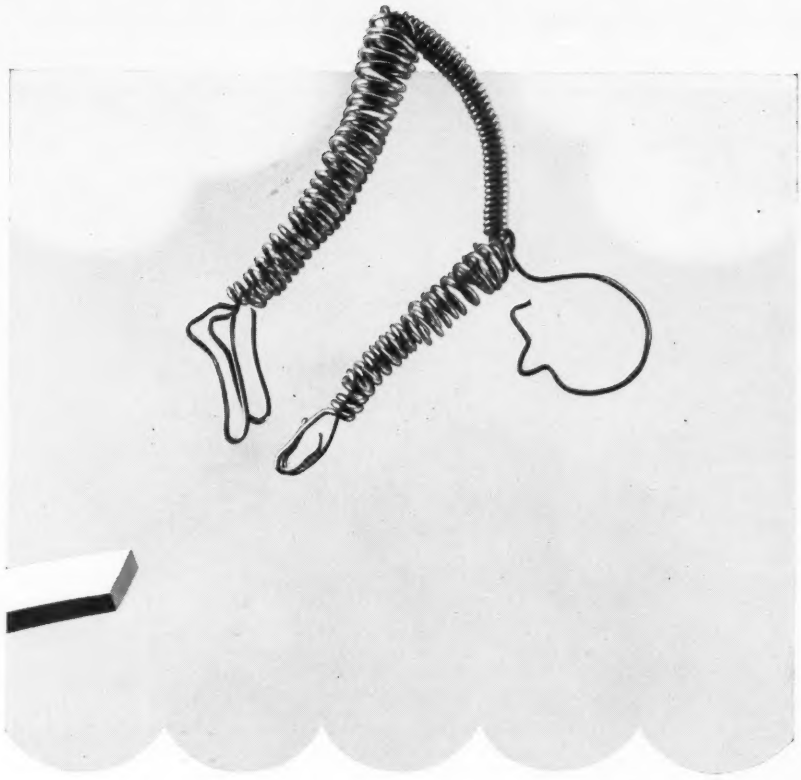
MEANS are provided for the operator to stop the machine at any point of the cycle and return all elements to the starting position if desired.

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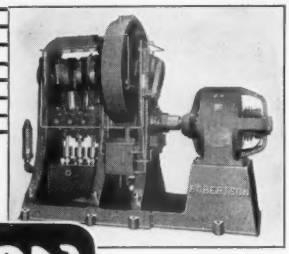

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With an eye to the needs of the Wire Industry, Robertson designed this modern high pressure pump . . . building in, 14 features that are essential to efficient performance in the field. The result, as amply demonstrated by actual use, is a pump that costs less to run and maintain . . . giving longer service and operating with uniformly high efficiency.

These features are the REASONS WHY —

1. Spring-balanced hydraulic safety relief valve of sufficient capacity to take the full capacity of pump without undue increase in pressure.
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6. Oil feed pump for gear-drive and all shaft bearings.
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8. Timken roller bearings.
9. Flexible coupling enclosed with a guard.
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11. Solid forged steel pump block with removable valve seats.
12. Deep packing chamber to insure long life of hydraulic packings - easy to get at.
13. Non-rust steel plungers, ground and polished.
14. Bronze bonnets on pump chamber - they will not rust.

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## Wires Employed in Dentistry

(*Continued from Page 468*)

joint. In spite of this fact, the wire exhibits no grain growth under any of the abuses indicated on the chart, and it is undoubtedly a very satisfactory product in spite of its complicated reactions to heat treatment.

✦ ✦ ✦

THE results of some work done on the strength of the soldered union as carried out in the physics laboratory at Northwestern University Dental School are shown in Figure 2. Wire A is the wire previously described, but wire B contains more gold and less platinum and palladium. The composition of wire C by weight percentage is platinum, 40 per cent; palladium, 30 per cent; and silver 30 per cent. Solders of 650 fine and 490 fine respectively were employed for the unions. The joints and wires were first air-cooled from the soldering temperature, then "softened" by quenching from a ten-minute aging at 1300° F. They were then hardened by the standard oven-cooling treatment described above.

✦ ✦ ✦

IT is interesting to note that in the case of wires A and B, the strengths of the two joints of each wire in the hardened condition are very nearly identical, yet for the other treatments, the joints constructed with solder 650 fine are definitely weaker. In all cases, the joint was found to be weaker than the respective wire, but stronger than the solder itself. Moreover, all of the joints fractured in the solder, and never in the wire. In other words, the strength of the joint is dependent on the composition of the wire, as well as the composition of the two solders. In consideration of these facts, it is reasonable to conclude that an atomic diffusion takes place between the wire and the solder, as well as from the solder to the wire. Such a consideration complicates the heat treatment of these joints considerably from the dental standpoint.

WIRE C in Figure 2 is worthy of special comment. According to its composition it should not be amenable to heat treatment, and this fact was verified by experiment. It is interesting to note in this case that the joint constructed with 490 fine solder also failed to heat treat, yet the 650 soldered joint responded to such treatment. It would seem that the dentist could obtain more uniform results by employing a wire which did not respond to heat treatment. It may be stated in this connection, that complete resistance to tarnish and corrosion in orthodontic work is not necessary, since the appliance is not permanent, and can be removed frequently for cleaning if necessary. A base metal wire of suitable properties should be available for this purpose, which will exhibit a recrystalization temperature of 1800-2000° F., and which will not respond to heat treatment below this temperature. Such a wire would be of considerable aid to the dentist from the standpoint of both efficiency and economy.

✦ ✦ ✦

## Stainless Steel Wire

THE use of stainless steel wire as a substitute for the precious metal wires, although it has a few staunch advocates, has not been completely successful. The "18-8" variety is the most popular among the users of this material, although other types might be equally or even more successful. So far the choice has been dictated chiefly by sales promotion. The wires are either soldered or welded. Silver solder is usually employed with a potassium fluoride-borax flux. The chief objections to the use of this material are the difficulties encountered in the joining of the wires. Not only are the soldering or welding processes difficult of manipulation, but also the temperatures employed inevitably anneal the wire, and since retempering by heat treatment is impossible, there is no manner by which the original elasticity of the wire can be restored in the finished restoration

(*Please turn to Page 498*)

ES

You are invited to visit our exhibit of wire drawing machines—
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Type BB-13 (Coiler Block) Wire Drawing Machine

| | |
|---|---|
| Size of finished wire | #26 to #34 B & S gauge |
| Number of operating dies | 13 (minimum slip) |
| Speed of finished wire | Up to 4000 F. P. M. |
| Coiler block | 8" diameter |

✦ ✦ ✦

COILER guard completely surrounding coiler block is furnished and an automatic stop to interrupt the machine when the coil is full is provided.

✦ ✦ ✦

FINISHING die is arranged to be aligned quickly and accurately. All driving parts are mounted on anti-friction bearing, are fully enclosed within the housing and splash lubricated from within.

✦ ✦ ✦

DRAWING block tires are made of hardened alloy steel, are economical and easy to renew.

A COMPLETE line, minimum slip, built primarily for high speed drawing — built for long life, efficient operation, economical production and clean and excellently wound quality wire.

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**to figure the cleaning time, the pickle liquor may not be at the right temperature.**

When you use Duriron Steam Jets, you can pull a stop-watch on the cleaning, and time it right to the second, knowing that when the work comes out that it is ready for the next operation.

Duriron Steam Jets heat quickly, circulate the liquor to prevent cold spots, and agitate it to keep the acid active. They save in cleaning time, do a better job, with less upkeep, and utilize the steam to the best advantage.

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for Cemented Carbide Dies

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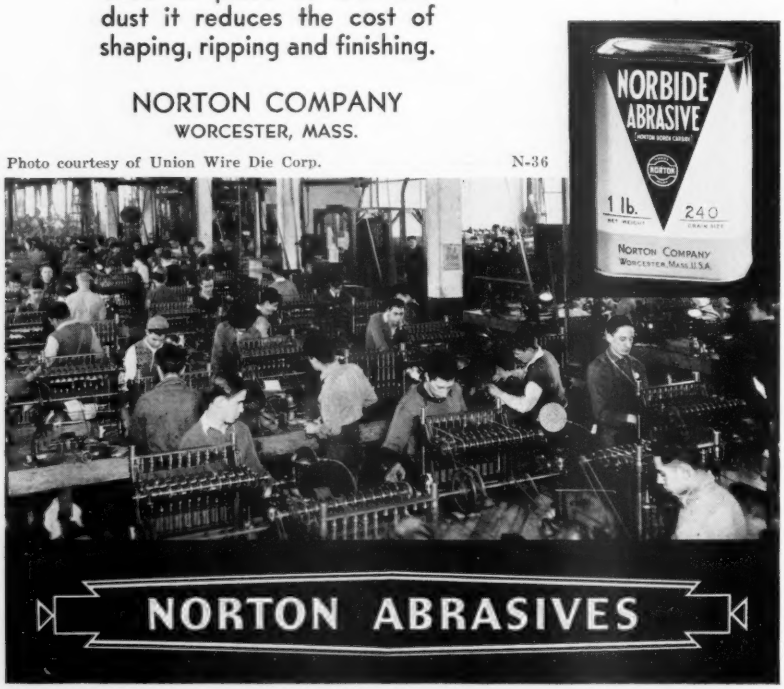
Photo courtesy of Union Wire Die Corp. N-36




NORTON ABRASIVES


## Wires Employed in Dentistry

(*Continued from Page 497*)

or appliance. Various changes in technique have been suggested to overcome these objections, but none of them are as efficient as the techniques employed with the gold-alloy wires.

✦ ✦ ✦

## Welding

WELDING as a means of union has not been used very extensively in dentistry. The spot welders supplied to the profession at the present time are manually operated, and the impossiblity of satisfactorily welding such small gauges without accurate timing is evident to anyone with experience in this field. If a satisfactory welding outfit with an automatic timing device could be manufactured within a price range which the dentist could afford, many improvements in dental technique would result with its use.

✦ ✦ ✦

## New Guarded Insulation-Resistance Test Set

USING a guarded circuit, this new insulation resistance test set made by the Leeds & Northrup Company is entirely free from the effects of leakage currents. The instrument conforms with the ASTM "Standard Methods of Test for D-C Resistance of Insulating Materials"—No. D-257-37T.

✦ ✦ ✦

SWITCHES are designed to simplify operation and eliminate calculation. Calibration of the galvanometer deflections is facilitated by the specially designed Ayrton shunt. Simply turning the shunt to the calibrating portion automatically connects the circuit for calibration. Results are obtained by merely dividing the calibration reading by the test reading.

✦ ✦ ✦

FOR further details, write for Catalog E-54(1), Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

## Reeves Announces an Improved Vari-Speed Motor Pulley, Countershaft Type

REEVES Pulley Co., Columbus, Ind., manufacturer of REEVES variable speed control equipment, has developed a new and improved design of the Vari-Speed Motor Pulley, countershaft type.

✦ ✦ ✦

THE Vari-Speed Motor Pulley is a simple, compact variable speed unit which is mounted on the standard shaft extension of any constant speed motor. It forms direct drive from motor to driven machine. Through handwheel control, a sliding base on which motor and unit are mounted is moved forward or back, varying the diameters of a set of adjustable discs from which a V-belt runs to the driven machine. Desired speed changes are made as the belt runs from maximum to minimum disc diameters.

✦ ✦ ✦

FOR requirements of either unusual speed reduction or speed increase, a countershaft is mounted on a common base with the rest of the unit. In the former design of this unit, the pulley on the countershaft from which power take-off was made to the driven machine, was mounted on the end of the shaft.

✦ ✦ ✦

IN the new design, this pulley may be mounted in the center of the countershaft. between the two bearing housings, thus providing a much more compact, space-saving unit in installations where this factor is important.

✦ ✦ ✦

WHILE a straight-face pulley is described, power take-off may also be from sprocket, pinion, multiple V-belt, sheave or any other accepted drive.

✦ ✦ ✦

THE countershaft supports are extremely strong, rigid and heavily braced so there is no possible chance of vibration or twisting in the countershaft.

✦ ✦ ✦

THIS Vari-Speed Motor Pulley is built in seven sizes, transmitting from fractional to 7½ h. p., and covering speed ratios of 3:1.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excels for wire drawing
Because . . . . . it is free from grit and other impurities . . . . . it has a guaranteed high content of Calcium . . . . . it is unusually slow-settling in the milk of lime box . . . it is truly economic in use . . . . . .

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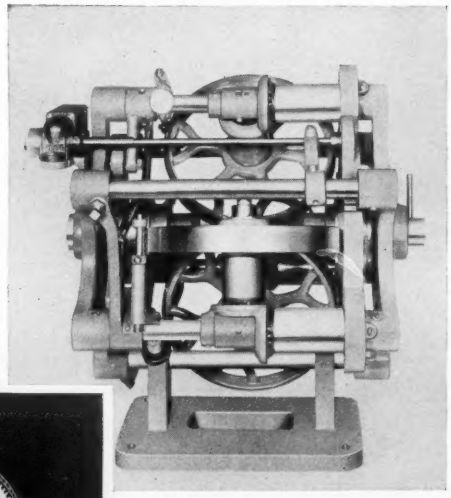
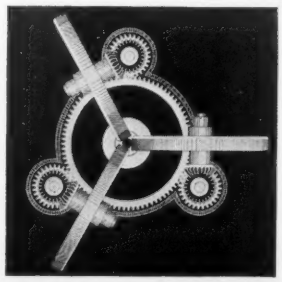
ACCURATE MEASURE

. . . this is the measuring machine you *must* use. Shows *exact* linear measurement of bare, insulated, twisted pair, oval, odd-shaped, cable. Absolutely accurate at any speed! Speeds up production; saves loss and waste.





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Special Equipment manufactured to meet special conditions.

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the universal standard.

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101 Blackstone St.
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## United States Steel Corporation Pioneers Color Photography In Industrial Films

CRANEMEN, millhands, miners and seamen will become screen actors when U. S. Steel Corp. pioneers the use of color photography in industrial educational feature films, it was announced recently.

✦ ✦ ✦

THE film, costing more than $200,000, will be made by Technicolor, Inc. Twenty steel plants will figure in the production.

✦ ✦ ✦

THE "shots" will constitute the first commercial feature in color. Introduction of this medium, combined with sound, will bring the screen presentation of steel production to a new high in realism.

✦ ✦ ✦

AN eight weeks' film itinerary has been planned starting at Hibbing, Minnesota, and winding up at Pittsburgh. At Hibbing, miners of the Oliver Iron Mining Co. will be filmed as they unearth the raw ore.

✦ ✦ ✦

IN nearby Duluth, seamen and loaders will be "shot" on the ore docks of the Duluth, Missabe & Northern Ry. Co. and decks of whaleback lake boats of the Pittsburgh Steamship Co.

✦ ✦ ✦

STOPPING next at Gary, Indiana, where the world's largest mill is located, the caravan will film blast furnaces, coke works, open hearth furnaces, and rolling mills in action. The large Gary rail mill also will be featured.

✦ ✦ ✦

SWINGING back through Chicago, the photographers go to Waukegan, Illinois, to shoot wire drawing and rod production operations of the American Steel and Wire Co. Pictures also will be made of the manufacture of fence, nails, and other wire products.

✦ ✦ ✦

CLEVELAND is the next scheduled stop. There the National Tube Co.'s pipe and tube operations at nearby Lorain, Ohio, will be photographed. Leaving Cleveland, the movie troupe goes to Pittsburgh where the Homestead Mills will be "taken" as they roll out the hot metal.

✦ ✦ ✦

McKEESPORT, Pa., also will be visited in order to "catch" a Bessemer converter in operation and the "Road Company" winds up its program at Chicago.

✦ ✦ ✦

THREE reels of color film are to be made, supplemented by six of black and white. In order to catch the various phases of operation in color, portable lighting equipment capable of furnishing street illumination to a city of 100,000 population will be employed by the film company.

✦ ✦ ✦

THE use of color and sound will make a vivid picture as, in all of the Company's subsidiaries contrasts are abundant. The reds and yellows of molten metal, the lighted interiors of subterranean mine passages, and the blue-green of the Great Lakes will present rich fields to the color camera.

**WHOEVER UNDERSTANDS GERMAN**
Should Read
"Draht-Welt"
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A weekly for the wire industry and related lines.

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Germany

## Recent Progress in Cold Heading Machinery

(*Continued from Page 483*)

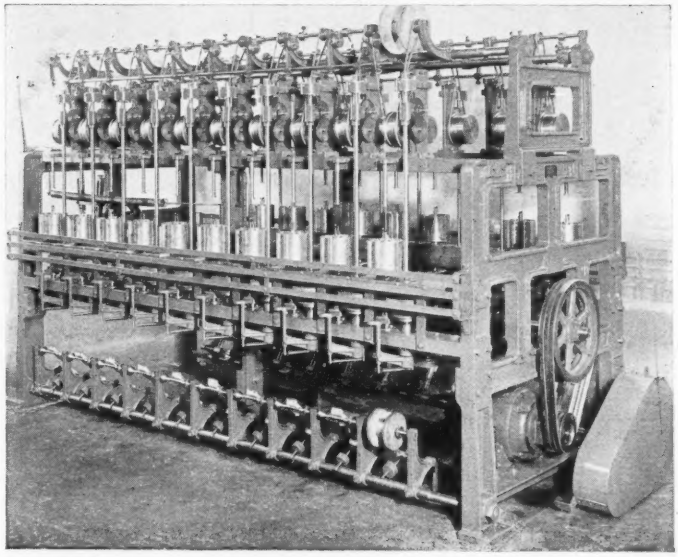
coning tool and cause trouble on the next stroke. In addition, when the rear end of the crop and the front end of the new coil reaches the cutter, two more short blanks would be sheared off and cause the same trouble. To eliminate this difficulty is the new machines, the feed rolls are automatically stopped before the end of the coil passes the rolls. This keeps the crop end under control and permits the operator to butt the end of the new coil against the old one. The feed is then started and when the two ends reach the cutter the operator pulls a conveniently located lever, which moves the transfer finger away from the cutter and permits the short blanks to drop harmlessly out of the machine. In this way only an extremely short piece from each end of the coil goes into the scrap pile, and there is practically no loss of production when starting a new coil. This simple and efficient arrangement is pictured in Fig. 7.

✦ ✦ ✦

TO insure long life to the moving parts, anti-friction bearings are used in this new design, and the the machine is lubricated by a built-in full-automatic cascade lubricating system.

✦ ✦ ✦

A FULL consideration of these ultra-modern machines, which are now available in both solid and open die types of various sizes, discloses that they are fully capable of meeting the most exacting requirements. They not only produce more accurate and better finished work, but the monthly output and the die life have been so vastly improved and the maintenance cost so greatly reduced that the ultimate cost per piece turned out is far less than ever before. The High Production, Precision Cold Header has now taken its place with "The Master Tools of Industry".

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## Wire Inspection Committee Appointed By A. S. T. M.

THE 1937 report of Committee A-5 on Corrosion of Iron and Steel includes a report of the Wire Test Committee and an extensive appendix details the types of materials tested, the number of samples to be exposed, information on the 11 test locations and other data.

✦ ✦ ✦

THE referee testing of all materials exposed in the test have been begun at the National Bureau of Standards and when the complete data have been obtained a supplement will be published so that complete information on all materials will be available in the Society publications.

✦ ✦ ✦

WHEN these data are issued the work of the original wire test committee will have been completed and the inspection of the materials, publication of the inspection data and conclusions drawn from these country-wide tests, which involve almost 11,000 test specimens aggregating almost ten miles of plain wire, barbed wire, strand, farm fence, and chain-link fence, will be the responsibility of the Wire Test Inspection Committee. This inspection committee has just been appointed and consists of the following members:

✦ ✦ ✦

C. D. Hocker, chairman, Bell Telephone Laboratories, Inc.; S. A. Braley, Pittsburgh Steel Company; F. M. Crapo, Indiana Steel & Wire Company; F. C. Elder, American Steel & Wire Company; E. V. Gent (C. C. Bartells, alternate), American Zinc Institute; W. H. Finkeldey, Singmaster & Breyer; F. V. Hammel, Whitall Tatum Company; H. H. Harman, Bessemer & Lake Erie Railroad; L. W. Hopkins, American Chain & Cable Company, Inc., (J. J. Maher, alternate, Page Steel & Wire Company); B. A. Jennings, Cornell University; C. A. Kellogg, Continental Steel Corporation; R. F. Passano, American Rolling Mill Company; H. S. Phelps, Philadelphia Electric Company; H. S. Rawdon, National Bureau of Stand-

ards; R. S. Simmons, Keystone Steel & Wire Company; H. E. Smith, Materials Engineer, and L. H. Winkler, (J. L. Gregg, alternate), Bethlehem Steel Company.

✦ ✦ ✦

### Pickling Steel With Modern Inhibitors

UNDER the above title a new booklet has been recently issued by the Research Staff of **E. F. Houghton Co.**, Philadelphia, Pa. This booklet is a manual on all phases of the science of pickling, as well as describing the advantages of Houghton inhibitor—ACITROL No. 100.

✦ ✦ ✦

AN outline of the history of inhibitors is presented, followed by a technical discussion on the electrolytic theory of inhibitors; an impartial discussion of modern pickling procedures, apparatus, and material handling is presented together with tables of computations covering the volume and weight of acids and solutions in storage tanks, vats, etc.—altogether a useful and informative publication. A copy may be obtained by addressing the Editor of WIRE & WIRE PRODUCTS, 17 E. 42nd St., New York, N. Y.

✦ ✦ ✦

### Beryllium Copper

THIS is the title of a booklet recently issued by the **Riverside Metal Company** of Riverside, N. J., containing very interesting data relating to this metal.

✦ ✦ ✦

THE booklet contains general information about Beryllium, its composition, the forms in which it is available; the application of the metal, together with methods of cold working, hot working, heat treatment and fabrication, followed by data on cleaning and pickling methods.

✦ ✦ ✦

THE use of this metal is becoming more prevalent in sheet, strip, wire, rods, springs, etc., than ever before, and a copy of this booklet shold be of interest to all production men of the industry. A copy may be obtained by addressing the Editor, Wire & Wire Products.


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*Straightener Specialists Since 1866*

The 1937
Wire Association Meeting
Will be Held at
Atlantic City, N. J.
October 18th to 22nd, 1937

## Exports and Imports of Wire

(*Continued from Page 488*)

and steel strips (287), 'other' pipe (263), and round iron and steel wire (228). Sixth was Norway (2,579 tons) who sent in principally ferromanganese (2,181), ferrosilicon (236), and pig iron (100).

✦ ✦ ✦

CARD CLOTHING imports totaled 36,198 square feet valued at $59,713 (28,867 square feet and $45,271) and were imported from the United Kingdom (33,880 square feet and $55,245), Germany (1,274 square feet and $1,870), Belgium (852 square feet and $1,409), and Switzerland (192 square feet and $1,189).

✦ ✦ ✦

THE June WIRE HEDDLE total was 1,336,000 pieces (714,000 pieces in May) and came from Germany (904,000), Belgium (200,000), France (171,000), and Switzerland (61,000).

✦ ✦ ✦

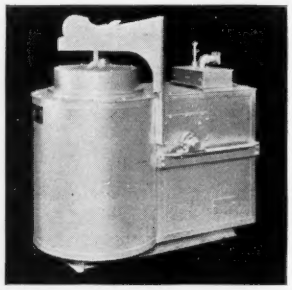
WIRE CLOTH AND SCREENING came in to an aggregate of 124,013 square feet (109,833) with Germany (64,183), and Netherlands (23,670), France (11,573), Canada (11,138), and Japan (7,075), the main suppliers.

✦ ✦ ✦

RECEIPTS of WIRE FENCING AND NETTING of the galvanized before weaving grade added up to 156,375 square feet (no trade in May), and came entirely from the Netherlands. Of that galvanized after weaving, 1,023,580 square feet came in (1,761,900 square feet) from Germany (409,800), the Netherlands (383,500), Belgium (225,000), and the United Kingdom (5,280).

✦ ✦ ✦

IMPORTS of FOURDRINIER AND OTHER PAPER-MAKING WIRE at 61,841 square feet compared with 30,888 square feet received in May, and came from



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Germany (31,470), Austria (21,671), Sweden (5,945), and France (2,755).

✦ ✦ ✦

EXPORTS of iron and steel wood screws during June, 1937 totaled 24,557 gross valued at $5,131. Of this total Guatemala took 6,050 gross valued at $1,293; Union of South Africa 4,750 gross valued at $655; Cuba 3,315 gross valued at $671; Dominican Republic 3,075 gross valued at $384; Colombia 1,317 gross valued at $339; Canada 817 gross valued at $151.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 6,615 gross valued at $3,820. Of this total Bermuda took 2,501 gross valued at $1,056; Panama 845 gross valued at $1,051; Venezuela 660 gross valued at $345; Canada 651 gross valued at $340; Argentina 625 gross valued at $329.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 38,433 gross valued at $3,923. Of this total Belgium supplied 32,660 gross valued at $3,548; Italy 5,600 gross valued at $362; and Japan 173 gross valued at $13.

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Norton Co., Worcester, Mass.

**HANDLING EQUIPMENT — Material**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**HOISTS—Electric Traveling**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**HOISTS—Monorail**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**INHIBITORS**
American Chemical Paint Co., Ambler, Pa.

**INSTRUMENTS—Electrical**
Leeds & Northrup Co., Philadelphia, Pa.

**INSULATION — Cable or Cable Filler**
E. W. Twitchell, Inc., Phila., Pa.

**LATHES—Die Reaming**
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

**LIME—Pulverized**
Warner Company, Bellefonte, Pa.

**LUBRICANTS—For Metal Cutting, Stamping and Drawing**
Magnus Chemical Co., Garwood, N. J.

**LUBRICANTS—Wire Drawing**
Magnus Chemical Co., Garwood, N. J.
R. H. Miller Co., Homer, N. Y.

**MACHINERY—Armoring (Cable, Wire Hose)**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Braiding**
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Brazing**
Thomson-Judd Wire Machinery Co., Lynn, Mass.

**MACHINERY—Bunching**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Bundling, Scrap**
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Cable, Electric**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Chain Making**
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Closing**
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Coil Winding**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Coilers**
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Cold Heading**
National Machinery Co., Tiffin, Ohio.

**MACHINERY—Copper Wire Drawing and Rolling**
Elevator Supplies Co., Inc., Rahway, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Cutting**
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Enameling**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.

**MACHINERY—Extruding**
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Flat Wire**
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Forming**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Galvanizing Wire**
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Gang Winders**
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Grinding**
Norton Co., Worcester, Mass.

**MACHINERY—Insulating**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Syncro Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Lead Encasing Presses, etc.**
John Robertson Co., Brooklyn, N. Y.

**MACHINERY—Lead Stripping**
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Lock Washer**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Magnet Wire**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Material Handling**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**MACHINERY — Measuring Wire & Cable**
Durant Mfg. Co., Milwaukee, Wis., and Providence, R. I.
Lyon-Vail Machine Co., Inc., Brockton, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Nail and Tack**
Glader, Wm., Machine Works Co., Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Panning**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.

**MACHINERY—Pointing**
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Rod Mill**
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

**MACHINERY—Rolling Mill**
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Rubber Strip Covering**
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Rubber Tubing and Straining**
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Screw Wire**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Special**
Amer. Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY— Special — Combination Machine for Drawing, Cutting-to-length. Straightening and Reeling Bars from Coil in One Operation (Schumag Type)—**
W. A. Schuyler, New York, N. Y.

# BUYERS' GUIDE, Continued

**MACHINERY—Spooling**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Spring Making**
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

**MACHINERY—Staple**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Straightening**
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Stranding**
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Strip Steel**
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.

**MACHINERY—Swaging**
Elevator Supplies Co., Inc., Rahway, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Taping**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Testing Size of Wire**
Torrington Mfg. Co., Torrington, Conn.

**MACHINERY—Testing Wire**
Henry L. Scott Co., Providence, R. I.

**MACHINERY—Tinsel Rolling Mills**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.

**MACHINERY—Trolley Wire**
Vaughn Machinery Co., Cuyahoga Fall, O.

**MACHINERY—Tube Mill**
H. J. Ruesch Machine Co., Newark, N. J.

**MACHINERY—Welding Wire**
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

**MACHINERY—Winding**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Wire Drawing**
Amer. Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Wire Rope**
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Wire Tinning**
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.

**MACHINERY—Wrapping Wire**
W. A. Schuyler, New York, N. Y.

**MATERIAL HANDLING EQUIPMENT—**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**MILLS—Tandem Rolling and Edging**
Torrington Mfg. Co., Torrington, Conn.

**MONORAIL SYSTEMS—**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip**
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

**OVENS—Annealing or Drying**
Lindberg Engineering Co., Chicago, Ill.

**PAPER—Insulating**
E. W. Twitchell, Inc., Phila., Pa.

**PATENT ATTORNEYS—**
Lancaster, Allwine and Rommel, Washington, D. C.

**PICKLING COMPOUNDS—**
American Chemical Paint Co., Ambler, Pa.

**POTS — Annealing, Case Hardening and Tempering**
Lindberg Engineering Co., Chicago, Ill.

**POTS—Lead Melting**
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

**PRESSES—Hydraulic and Mechanical**
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

**PRESSES—Lead**
John Robertson Co., Brooklyn, N. Y.

**PULLERS—Wire**
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

**PUMPS—Hydraulic**
John Robertson Co., Brooklyn, N. Y.

**PYROMETERS—**
Leeds & Northrup Co., Philadelphia, Pa.

**RECORDERS—**
Leeds & Northrup Co., Philadelphia, Pa.

**REEL AND TENSION STAND—**
Sleeper & Hartley, Inc., Worcester, Mass.

**REEL CRUTCHES—**
Watson Machine Co., Paterson, N. J.

**REFRACTORIES—High Temperature**
Norton Co., Worcester, Mass.

**ROD BAKERS—**
Morrison Engineering Co., Cleveland, O.

**RODS—Stainless Steel**
Rustless Iron & Steel Corp., Baltimore, Md.

**RODS—Wire—Non Ferrous**
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

**RODS—Wire—Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

**ROLLS—**
Farrel-Birmingham Co., Ansonia, Conn.

**RUST PROOF COMPOUND—**
American Lanolin Co., Lawrence, Mass.

**SHEET—Steel**
Continental Steel Corp., Kokomo, Ind.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

**SKIN PROTECTOR—**
Magnus Chemical Co., Garwood, N. J.

**SOAPS—Industrial and Wire Drawing**
Magnus Chemical Co., Garwood, N. J.
R. H. Miller Co., Homer, N. Y.

**STAINLESS STEEL—**
Rustless Iron & Steel Corp., Baltimore, Md.

**STRIP—Brass, Zinc and Non Ferrous**
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

**STRIP—Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

**TANKS—Compound**
Watson Machine Co., Paterson, N. J.

**TESTERS—Wire**
Henry L. Scott Co., Providence, R. I.

**TRAMRAIL SYSTEMS—**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**TREADS—Safety**
Norton Co., Worcester, Mass.

**TRUCKS**
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Fall, O.

**TUBE BENDERS AND FORMERS—**
H. J. Ruesch Machine Co., Newark, N. J.

**VALVES AND FITTINGS—Acid Proof**
Duriron C., The, Dayton, O.

**VULCANIZERS—**
Watson Machine Co., Paterson, N. J.

**VULCANIZING PANS—**
Amer. Insulating Mach'y Co., Phila., Pa.

**WIRE—Cold Heading**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

**WIRE—Electric**
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

**WIRE—Enameled For Coils**
Winsted Div. of Hudson Wire Co., Winsted, Conn.

**WIRE—Manufacturers**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

**WIRE—Nickel Silver and Phosphor Bronze**
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

**WIRE—Non Ferrous to Specification For Special Purposes**
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

**WIRE—Spring**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Seymour Mfg. Co., Seymour, Conn.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

**WIRE—Stainless Steel**
Rustless Iron & Steel Corp., Baltimore, Md.

**WIRE—Steel—Also Copper Steel—Also Galvanized Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

**WIRE AND STRIP—Brass, Zinc**
Platt Bros. & Co., The, Waterbury, Conn.

**This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.**

# THE WATSON MACHINE COMPANY

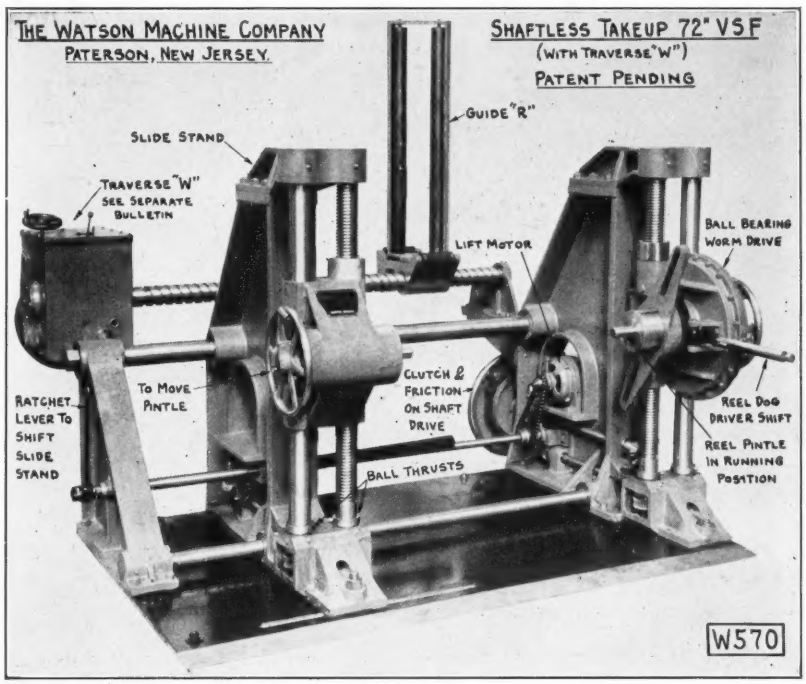
ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

**ENGINEERS - FOUNDERS - MACHINISTS**

## SHAFTLESS TAKEUPS TYPE "V"

**For Heavy Duty**
*(Patent No. 1825218)*




## THE MOST IMPORTANT SINGLE POINT OF THIS TYPE THE ELIMINATION OF THE REEL SHAFT

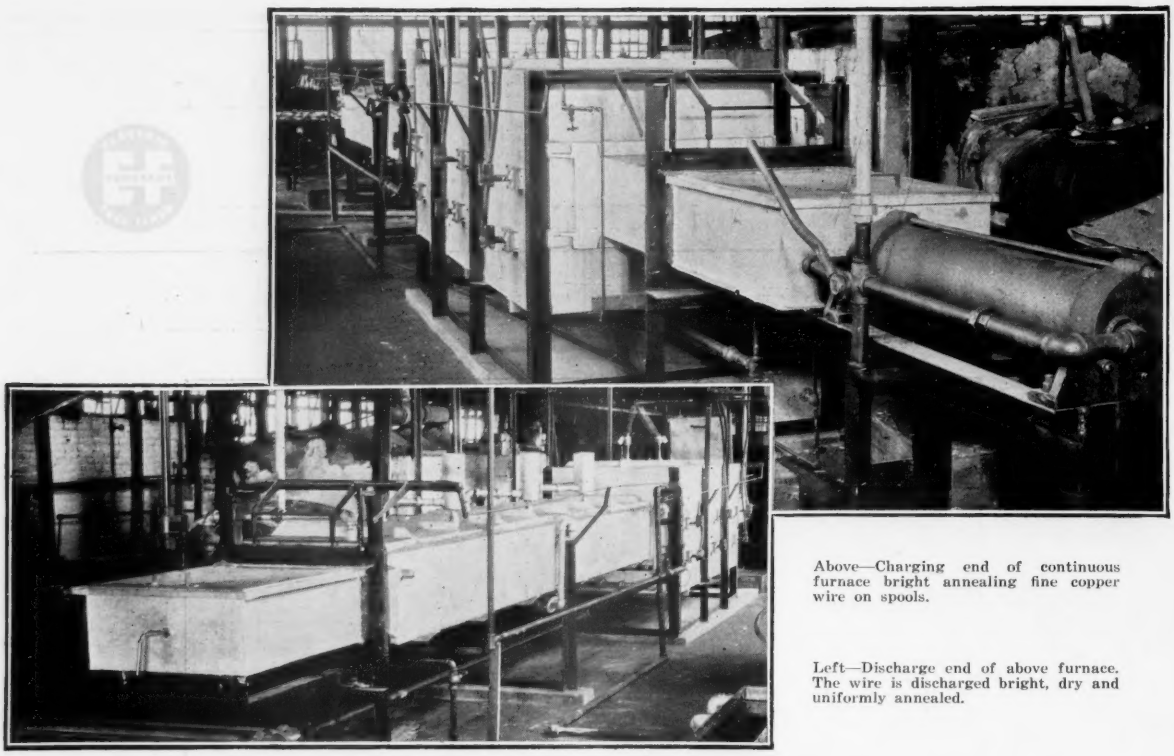
The elimination of minor injuries to operator in handling large reel shafts is also a point of considerable value.

Three sizes are built—

72″ and 84″ for loads up to 6 tons (picking up 36″ or larger reels from base).

96″ for loads up to 10 tons (picking up 48″ or larger reels from base). The multiple disc slip-friction is adjustable in operation and this, with the slack takeup handwheel combined with positive clutch, centers drive control at the stand in a convenient position.

**ELECTRICAL WIRE AND CABLE**
**WIRE ROPE and CORDAGE MACHINERY**



Above—Charging end of continuous furnace bright annealing fine copper wire on spools.

Left—Discharge end of above furnace. The wire is discharged bright, dry and uniformly annealed.

## Another Special Atmosphere Furnace

**similar to the above is now being built**

## For Bright Annealing Fine Copper Wire on Spools

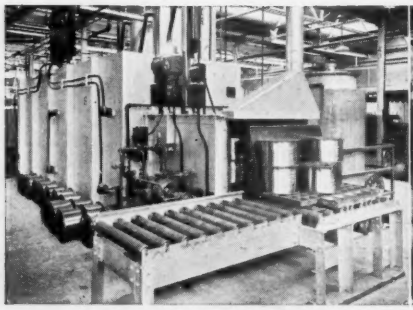
**—Uniformly, Economically, Continuously—Bright and Dry**

**No steam, vapor or water seals of any kind are used in these continuous, controlled atmosphere furnaces —thus staining is entirely eliminated and no drying necessary,—the wire is delivered from these furnaces uniformly annealed, bright and dry; ready for shipping, further processing or fabricating. This is one of several types of electric and fuel-fired furnaces we have developed and built for the wire industry —both ferrous and non-ferrous.**

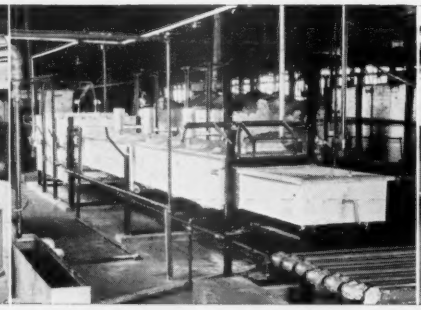
**Other recent installations include furnaces for bright-annealing heavy and fine copper wire on large reels and spools and in coils and for clean annealing brass wire—an improved pit type furnace for normalizing and annealing steel wire in coils, and furnaces for scale free hardening, billet heating, bright annealing, copper brazing, carburizing, and other heating and heat treating processes.**

**If you are interested in improving the quality of your anneal or heat treatment; increasing production or contemplating any changes or additions to your furnace equipment, our engineers will be glad to work with you. We specialize on building furnaces to fit the customer's particular problem.**

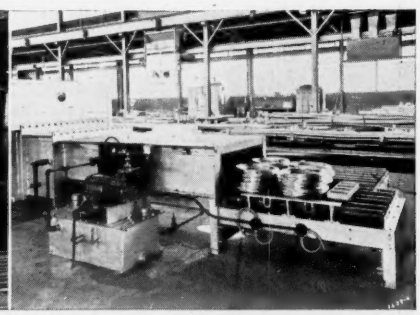
# The Electric Furnace Co., Salem, Ohio



**BRIGHT ANNEALING COPPER WIRE**
— on large reels — 36,000 lbs. per day



**BRIGHT ANEALING FINE WIRE**
— on small spools — 5 tons per day



**BRIGHT ANNEALING COILED WIRE**
— bronze, copper, nickel-silver, etc.